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The Institute of Vitreous Enamellers

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and

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Shop Floor Analysis

It is usual for a machine-shop manager to provide himself with a large-scale plan of his shop showing the position of each machine, and, moreover, it is quite common for him to rearrange these machines to suit alterations in the production programmes. Many foundry executives are similarly catered for, but, in general, there are wide expanses of floor space allocated to light, heavy, or medium castings which remain a permanent feature on the plan. We remember that many years ago Mr. A. Smith, who then had charge of the Morris Motor Company's foundries before their rebuilding and mechanisation, provided himself with scale models of his moulding machines which were redistributed from time to time to meet the demands placed upon the floor. He was, in some respects, fortunate in having only one customer, but where a foundry has a number of customers it is often desirable, as both an aid to costing and to planning, to have the foundry floor divided on a large plan into areas and to affix to each area a cardboard slip carrying a few details of work to be done and actually being carried out. By a simple colour scheme it can be shown which areas are likely to become vacant in a few days, a few weeks, or those which are permanently reserved. The information so given enables the foundry executive to ascertain almost instantaneously when deliveries can be started on new orders; it indicates to the sales department the type and quantities of castings needed to balance production. It is suggested that not one plan should be used, but several. For instance, plan No. 1 would show the day to day utilisation of the floor space, whilst another would show its appearance the next day, and a third the programme for the beginning of the next week. If the plan be sufficiently largely scaled the daily production can be entered up and a filing box, compiled to correlate with the plan, could be used for a period to evaluate overhead costs on a floor utilisation basis. This plan has much to commend it, as it would show the position of orders and the daily production with reference to books and papers. If a foundry be attached to an engineering shop, then in place of customers' orders, names or other details of components would appear. Conferences with the works manager would be shortened, and decisions to allocate further space to urgent work at the expense of other details could be made with a minimum of argument and probably at the same time exhibit a maximum of propaganda for increased manufacturing facilities or, perhaps, even a new shop!

New Trade Associations

The marked improvement in trade has resulted in the formation of a number of groups of makers of particular products or plant, the participants in which have a common interest in the business contacts such groups afford. The story of the formation and dissolution of these groups is the story of trade fluctuations. Formed when trade revives, they increase with trade and become powerful as it reaches its peak. When the inevitable decline sets in, they weaken and disruptive influences show themselves. As soon as the need for the market becomes a scramble, they pass out. We believe, however, that business men to-day understand the nature of the business cycle better than ever before, and that trade associations may thus be used not by raising prices unduly to bring about the reaction and ultimate decline, but to postpone it. How can this be done? The reaction usually sets in when price levels become uneconomic and deliveries too prolonged. Hence trade associations can do much to maintain business stability by holding prices, and by resisting upward movements, and by facilitating the flow of work to those plants most suited to do it, thus making for economy of production and deliveries.

We have always believed that there are other functions for trade associations even more important than price-control. These are so lengthy and various that a book could be written on them, but it suffices to say here that they include the whole of the legal and governmental aspects of the industry, the questions of research and development, relations with labour, apprenticeship, market research and statistics, accidents, and so on. It is not necessary for every trade association to do the whole of this, but by proper co-ordination a suitable division of functions can be arranged.

We have heard of several of these associations being formed in close connection with the foundry trade, and we wish them every success in dealing with the problems for which they were set up. In particular, the position respecting imports at a time when home plants are strained to capacity, becomes very delicate and wants wise handling.

Annual Dinner of Scottish Foundrymen

The annual dinner of the Scottish Branch of the Institute of British Foundrymen was held in the Grosvenor Restaurant, Glasgow, on December 12.

MR. FRANK HUDSON (Branch-President) occupied the chair, and was supported at the high table by the Lord Provost of Glasgow, Bailie Winterton (President of the Institute), Mr. W. H. Smith, of West Bromwich, Mr. E. Bruce Ball (Glenfield & Kennedy, Limited), Prof. Percy Hillhouse, D.Sc., Prof. Wm. Kerr, Ph.D., Mr. Norman A. W. Erskine, Dr. A. McCance, and Mr. T. Makemson (general secretary of the Institute).

MR. W. H. SMITH, in proposing the toast of the City and Corporation of Glasgow, said that he still remembered his first visit to the city in 1916, although he had forgotten some of his more recent visits. Glasgow was noted for its heavy engineering works. There were some large engineering works in Birmingham, but they were not nearly so important as those in Glasgow. He did not see many of the shipyards in 1916, but since then he had been able to judge their magnitude and importance, for they had built the "Queen Mary," and he thought that we would be able to retain the blue ribband of the sea with the "Queen Mary's" sister ship.

THE LORD PROVOST OF GLASGOW, in reply, referred to the pleasure it had given him and the Corporation to receive the members of the Institute during the conference in June. He had wondered, when he received the invitation to be present at this dinner, if the members had enjoyed their stay so much in June that they had come back again. He found, however, that it was only the Scottish Branch he was then meeting, but it had been suggested that the Scottish Branch was really the important part of the Institute. He had come into close contact with members of the foundry industry, and was aware that the shipbuilding and engineering industries of Glasgow and the West of Scotland could not have arrived at their present eminent position without the help of the foundrymen. The foundry was the fundamental basis of them all.

Glasgow as an industrial centre had been suffering severe depression. Instead of having a large number of small industries, as Birmingham had, it had concentrated on the heavy industries. Cities, like individuals, were victims of circumstances. He sometimes wondered whether, in view of all the advances of science, we were working on the best lines. There were so many to-day without employment, and he thought that if the use of machinery caused unemployment, there must be something wrong with machinery. Glasgow tried, as far as possible, to make it its first business to supply a healthy environment for its citizens. To improve the housing conditions they hoped soon to build another 60,000 houses. The Corporation proposed to do the whole job themselves, not by private competition. Both ways had been tried and it was found that a large saving on each house resulted from employing direct labour. Glasgow had an advantage in being able to borrow money at a cheaper rate than any city in Britain.

The Institute

MR. E. BRUCE BALL, proposing the toast of the Institute of British Foundrymen, said that a great risk had been taken in asking a mechanical engineer, who had to use the foundrymen's products, to propose the toast. After referring to the expensiveness of cast-iron ware in the days of Dud Dudley and the endeavours to reduce its cost, he said that in 1762 Coalbrookdale foundrymen came to an agreement to charge identical prices for their castings. That appeared to be the start of the co-operation for the achievement of an economic price. Since that time there had been an advancement of the foundry craft and a little research. The foundry industry demanded high qualifications from its employees and he believed that a high standard was attained largely through the Institute. The Institute was in advance of other socities inasmuch as it had 10 Branches and it allowed much more self government to its Branches than did other societies. Advancement of the industry was evident when one recalled the old dark and ill-ventilated foundries and compared with the present-day well-lit foundries. The facilities for instruction placed the industry on a high plane.

MR. H. WINTERTON, in reply, said that since 1905 he had taken a great interest in the work of the Institute, but so far as the financial side of the industry was concerned the Institute had nothing to say; it was mainly concerned with improvement of the technique and research work.

The Institute was started in 1904 in a small way when a meeting was held by a few enthusiasts in Birmingham under the presidency of Mr. Robert Buchanan. To-day the membership was over 2,000 and there were 10 Branches. The aim of the Scottish Branch was to exceed a membership of 300 during the present session as this figure had eluded them for some time. The Branch was still growing in numbers and in usefulness and the General Council appreciated its good work and progress. Collaboration with other institutes was progressing; this benefited the industries of the country and the nation in general.

A Scholastic Toast

MR. N. A. W. ERSKINE, in proposing the toast of technical and educational institutions, said the toast covered such a wide field that it was difficult to do justice to it in the time available. Confining consideration to the West of Scotland, he thought the links in the chain of progress were being connected together. It started with the schools in the elementary stage and progressed through the secondary and advanced stages to the technical schools and the Royal Technical College and, finally, the technical societies, each in its own field and standard of learning. Glasgow made much provision for acquiring knowledge. In the joint syllabus of technical societies which was issued annually one found 25 societies meetings in the engineering and 10 in the chemical sections of industry. The subjects dealt with at the meetings showed the amount of research undertaken by individuals and the amount of generosity which prompted the preparation of Papers and discussions. Mutual advantage was gained by holding joint meetings with other societies because a subject could be viewed from different angles. The collective effort increased the rate of progress and the standard attained, and the concentrated effort of all members tended to increase the value of all societies. Glasgow and West of Scotland had reason to be proud of its technical and educational institutions.

PROF. PERCY HILLHOUSE said the technical societies were important to industry, they acted as media for the publication of the latest information. Papers could be divided into three sections: (1) purely advertising; (2) historical and useful for reference and (3) pioneering. Transactions of societies showed that some Papers were outstanding and became classics, such as the Papers of Froude. All young men should advertise themselves and get themselves known. It was possible only to give young men guidance; one could not instil knowledge into a man if he did not do something for himself.

The Local Branch

PROF. WM. KERR, Ph.D., said it was his privilege to convey greetings to the Scottish Branch in the absence of Sir Thomas Hudson Beare, the chairman of his society (The Institution of Mechanical Engineers), who was unable to be present. In reading the last annual report he had noticed that the Branch carried on its work in three centres, Glasgow, Falkirk and Edinburgh, and that the secretary was somewhat outspoken regarding the Edinburgh section, which was described as difficult. His institution had sections in Edinburgh, Aberdeen and Dundee, as well as Glasgow. These centres corresponded with the sections of the foundrymen. Falkirk might be considered the equivalent of Aberdeen. The Institution of Mechanical Engineers had also found Edinburgh difficult. Translating the characteristics of the various cities into metallurgical terms, he suggested Glasgow would be of open structure, Falkirk close grained, and Edinburgh amorphous. Aberdeen was more cautious. He had seen in Glasgow a large factory where one portion was built on the German economical system of design and the other by a Glasgow firm on more substantial and massive style. The glass in the Scottish built section had remained intact, but in the German built portion every pane of glass was cracked or broken due to vibration. The Germans knew every bit as much about engineering design as the Scottish engineers, but the latter were more cautious and played for safety. He considered that in the complexity and movement in design the Scottish caution was necessary. The turbine and internal combustion engine were factors in life to-day and it was necessary to have strong design and strong material.

The Scottish branches of all the institutes performed a useful function in retaining these careful tendencies, but in doing so they called for more co-operative effort and concentrated study. He thought an allied effort by all institutions would result in restraint in adopting new discoveries and prove of greater value than the present system of detached effort. Engineering research and education were of great advantage to all concerned in industry, and the Branch took a prominent place in the advancement of these activities.

MR. FRANK HUDSON (Branch-President) thanked Prof. Kerr for the manner in which he had proposed the toast of the Branch. The Scottish Branch had taken a very important part in the work of the Institute during the past year, as it had provided both an annual conference and a President. He thought it was an honour for the Branch to have Mr. Winterton in the position of President of the Institute. He took the opportunity of thanking the Branch members for their support at the conference, and especially Mr. D. Sharpe (immediate Past-President) for the manner in which he had supported Mr. Winterton. There had recently been an improvement of trade in the Scottish area, and he looked forward to an expansion in the membership and activities of the Branch. It was generally admitted that light was the best detector of criminals, and he thought it was equally true in industry. Science was making such rapid strides that industry was hard put to it to keep up with new discoveries. The function of the Institute was to turn the light on to these advances and make them clear to industry. What would it be in the future? Experiments were being made with superphonic waves, and at present they were used in the sounding of ships and on the structure of metals. Experiments which had been made in Russia on the degassing of molten metals seemed to indicate that the waves induced a finer structure. Possibly it would soon be possible to have an imitation wireless set to use on metals and obtain what could at present only be secured by very strict metallurgical control.

MR. T. MAKEMSON proposed a vote of thanks to the artistes who had contributed to the entertainment and enjoyment of the function, and he included Mr. Bell (Branch Secretary), who had arranged the evening so admirably.

Cast Moulds for the Glass Industry

By R. D. SMITH

This article, which is taken from "Metals and Alloys," where it bore the title of "Metallurgical Needs of the Glass Industry," is of real interest to those foundries making ingot moulds. The author stresses the importance of cooling the glass moulds whilst ingot makers have sometimes found advantages from a wider spacing in the pits. The phase of a modicum of the malleability of the edges of the mould is not stressed in this article, but has importance where the Owens machine is used.

Materials for Moulds

The glassmaker still uses grey cast iron for the bulk of his moulds. This continued use of cast iron is not because he is unaware of the special alloy irons, stainless alloys and surface treatments at hand. The glass manufacturer was using stainless steels for moulds in 1920, and many other alloys and even chromium-plated moulds have seen service during the past 15 years. The glass manufacturer also welcomed nitrided Nitralloy as soon as this process and material were perfected and placed on the market.

Moulds of Grey Iron

The low initial cost, ease of machining, with low stock and obsolescence charges, while strongly in favour of the grey cast iron, are by no means the only reasons for continued use of that material for glass moulds. Due to the increased demands on the moulds either by increased production or higher quality of ware, glass manufacturers are, in general, dissatisfied with the performance of grey cast-iron moulds, and are continually searching for better materials. Some of the alloy irons supply certain properties required for moulds and are used when these requirements are pre-eminent. Steels and alloys of the stainless type are used for their resistance to oxidation and greater useful life before developing heat-checked surfaces. The main obstacles to the extended use of these special materials is that the important thermal properties of the latter differ markedly from those of regular grey iron about which the glass pressing cycle, and hence glass machines, have been developed.

Furthermore, the so-called high-duty irons and alloy irons, which have performed so well in commercial applications, have been found rather disappointing to the glass trade in respect to their ability to withstand the thermal fatigue with its resultant heat-checking of the mould surface. This latter observation is particularly true of press moulds in which the glass is pressed in one operation to its finished shape, as compared with press and blow moulds in which the glass blank is either pressed or blown from one set of moulds to a semi-set condition, followed by a transfer to the finish or blow mould. The latter process is essentially that used for making bottles. While many other desirable mould properties are similar to press and bottle moulds, it by no means follows that one type of material is suitable for both types of moulds.

Function of Glass Moulds

Since the function of the mould is to form the glassware to shape, it will be in order to describe some of the properties[1] of glass and mould materials of importance in this process. While glass in its molten state can be made to flow from an orifice in a forehearth, be sucked up into a "parison" or blank mould from a molten pool, or gathered on a blowpipe or punty iron, it is not generally free flowing and becomes progressively more viscous as it is drawn from the working end of a melting unit. In general, the viscosity of a glass of the soda-lime type doubles for each 55 deg. C. drop in temperature around 1,200 deg. C. At the annealing range, which is from 500 to 550 deg. C., the viscosity doubles for each 8 to 9 deg. C. drop in temperature.

While there is sufficient mobility to permit annealing of the glass in this lower temperature range, and some limited reforming operations may be made at 650 deg. C., the true working range is a limited field of somewhat higher temperature. This working range varies with the different glass compositions and the glass may have a short or long working range. Below the working range the glass is rather tender and susceptible to cracks or checks. Glass is strong under compressive stresses and weak under tensile stresses. Glass also has a tendency to wet or stick to hot metal surfaces, varying as to the sticking temperatures with glass or metal composition.

The function of the mould is to form the glassware, and the importance of the mould temperature in the glass forming cycle is apparent. Means for cooling the moulds after the release of the ware is provided with air, wind, or water jacket. While the mould may be returned to the glass receiving position at the desired surface temperature, the rate of heat flow determined by the thermal properties of the metal and oxide film seriously affects the setting-up cycle of the glassware. If the mould be too cold, the ware may have a chill wrinkled surface, not blown or pressed up fully to shape, or be checked in the process of shaping. With the moulds too hot, the fault may be in sticking of the glass at some part of the mould interfering with release of the ware, thus resulting in checking, deforming or mould scale adhering to the ware. The heat transfer from glass-to-metal is also affected critically around glass to metal sticking temperatures. The more intimate the glass-to-metal contact, the more rapid is the flow of the heat from the glass to the metal. The factors promoting this intimate contact are: Hot glass and hot mould body temperatures, pressure of glass against mould surface, mould surface polish, and, of course, time of contact.

The above description illustrates some of the difficulties in substituting one mould material for another, and the differences in blown and pressed ware forming the glassware. It will also be apparent that a decreased life of moulds may be due to the very slight changes in the operating conditions in order to improve ware quality as well as the rate of increase in output from moulds.

Factors Limiting Life of Moulds

In order to displace grey cast iron as glass mould material with special cast irons or special alloys, glass makers must first be assured that, for the service intended, the proposed material will offer advantages over the grey iron resulting in better and longer mould service. Assuming that a new mould is satisfactory for forming glassware on a given glass machine, some of the factors limiting the continued use or ultimate life of the mould are:—

The mould surface oxidises or becomes dirty in service and must be cleaned. This oxide film eventually affects the heat transfer balance and results in sticking, checking, or adherence to the glassware of metallic oxide. The mould may develop a heat-checked surface due to the thermal fatigue received in the cycle of heating by the glass and the artificial cooling. The failure may be by warping or growth, by loss of sharp pointings, joints or other faults caused by wear.

High-duty or special alloy irons as mould materials only partially meet mould metal requirements and do not appear to offer increased resistance to heat checking of the mould surface.

Certain moulds of the hot iron type, of which the bottle mould[2] is a typical example; and which parts are usually the half shape of the article or section of the glassware to be shaped, must possess freedom from warpage and growth, and also those physical properties which give resistance to wear and retention of sharp edges and joints. The tendency of such shapes to heat-check is not so pronounced as with block shaped or press type moulds. High duty alloy and high temperature cast irons of fine uniform structure are of distinct advantage in such mould shapes provided the alloy does not seriously affect expansion or thermal conductivity.

Some Facts about Press Moulds

With press moulds or solid moulds the resistance toward heat-checking of the mould surface is of importance, particularly with large mould shapes. Little difficulty is experienced with warpage or growth during the life of the mould. The high-carbon high-silicon cast irons, which the customary growth tests at elevated temperatures would tend to eliminate from consideration, are actually the best performers in resistance to heat-checking by actual tests as mould material, comparing favourably with service from the low-carbon low-silicon iron with or without alloy additions. It may be well to add that the analysis of two different grey irons may be almost identical and the service life decidedly different. In general, the proper blending of the irons in a cupola or furnace charge and the absence of steel or other low-silicon scrap appears to be important in the process of producing press mould castings. The presence of considerable phosphorus in the grey iron castings does not appear to be detrimental.

Some foundries make a speciality of press mould castings. Very few glass manufacturers order glass mould castings of the hardware iron type but buy them from the foundries specialising in that line of work. The high-silicon high-carbon grey irons are cast against a chill to obtain the desired glass forming surface. With press moulds the chill is always used and is necessary on all irons except those melted at very high temperatures and in which the graphite is naturally thrown out in a very finely divided condition. Experience with low-carbon low-silicon and similar alloy irons cast without chill indicate that for press moulds the surface is not sufficiently close grained for good press ware finish. There is a tendency for such unchilled irons to open up on the surface rather early in service. With blow moulds, the importance of chilled iron surface is not so great since the service does not appear to open the grain and the surface pattern may not be so faithfully transmitted to the blown ware surface.

Both the glass manufacturer and the foundryman recognise that the special irons developed for other purposes do not fill all the requirements of glass moulds. Attempts are now being made to develop suitable cast irons with the co-operation of the research and development staffs of the metallurgical industry.

Analyses of cast irons tried out as press moulds in one comparative test at the Corning

c2

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1 G. Gehlhoff. "Relations Between Physical Characteristics of Glasses and Their Working Properties on Machines," Journal, Society of Glass Technology, Vol. XII, No. 48, December, 1928, p. 145.
2 N. L. Evans, W. Goacher and J. E. Hurst. "Cast Iron for the Manufacture of Glass Bottle Moulds," abstracted in FOUNDRY TRADE JOURNAL, February 27, 1936, p. 171.
3 U.S. Patent No. 1,814,102.
4 U.S. Patent No. 1,449,789.
5 U.S. Patent No. 2,018,814.

Glass Works, Corning, N.Y., are given in Table 1. These analyses were made by the Vanadium Corporation of America in the course of an examination of the moulds and are presented with the kind permission of Jerome Strauss, Vice-President of the company.

In explanation of Table I it may be stated that a certain press mould part which undergoes severe service was selected for the test. Six moulds were ordered to be cast in each composition or range of compositions from the respective foundries. Four such mould parts were used in the mould set and so far as possible the set was made up of four different materials arranged in such a manner as to give a comparative test. The production and hours service were recorded and glassware from the moulds examined. The latter identification was obtained by a lettered code stamped in the mould. The orders for rejection of the mould, due to ware defects from mould causes, were left in the hands of the inspection department. A few of the irons could not be operated with the normal grey iron due to thermal properties which demanded different cooling conditions. These materials were operated separately to conform to the best service conditions suited to the mould material.

TABLE I.—*Analyses of Cast Irons Tried Out as Press Moulds.*

Material.	T.C.	Gr.C.	Si.	Mn.	S.	P.	Cr.	Ni.	Other constituents.
A-1926 ..	3.58	3.32	2.42	0.59	0.039	0.428	None	None	—
A-1934 ..	3.50	3.44	2.22	0.55	0.058	0.410	0.06	None	—
A-Mo ..	3.50	3.34	2.76	0.74	0.023	0.310	0.08	None	0.28 Mo
B-1 ..	3.70	3.30	1.99	0.57	0.053	0.250	0.07	None	—
B-2 ..	3.50	3.04	2.20	0.58	0.044	0.230	0.12	3.43	—
B-3 ..	3.57	3.19	2.27	0.58	0.044	0.230	0.06	1.92	1.98 Al, 0.21 V
C ..	2.93	2.51	3.36	0.21	0.021	0.032	1.99	0.85	6.03 Cu
D ..	2.75	2.23	2.34	0.41	0.103	0.210	1.74	14.73	—
E ..	3.38	2.75	1.32	0.49	0.093	0.140	0.29	1.43	—
F ..	2.99	2.46	2.30	0.50	0.047	0.240	0.45	1.84	—
G ..	2.53	1.84	2.15	0.60	0.049	0.062	0.09	None	—
H ..	3.81	3.39	1.84	0.58	0.055	0.240	0.10	None	—
I ..	2.11	1.65	0.90	0.80	0.043	0.180	0.04	—	—

The A type of iron gave the longest satisfactory service life which averaged 20 hrs. The A-Mo iron was not as long lived as the normal grey iron. The poorest service was obtained from the G, H and I irons. The I iron checked before coming to operating temperature and never pressed a passable piece of ware. The G and H irons gave only 8 and 6 hrs. average life.

The B-1 set of moulds was between the A and G type in length of service. The shape of the mould was not quite a fair test for C type iron[3] which cracked in service after an average of 16 hrs. Subsequent tests in mould shapes adapted to the properties of this alloy iron indicate that this material shows promise as a mould iron. The rest of the alloy irons B-2, B-3, D, E and F all gave better results than G, H and I, but failed to measure up to the A type in performance for one reason or another.

It may be generally stated that the alloy irons are better than average grey irons but not proved superior as yet to good mould grey iron. While the works were able to obtain a good total life from some of the alloy irons, yet in the middle of an 8-hr. shift, there was an opening up of the surface so that a change of moulds was necessary. A severe stoning removed this surface but the fogging of the pressed ware appeared to occur a little sooner on the next service run of these mould parts. The particular offenders were those irons which are customarily cast without chill.

Moulds of Stainless Steels

Stainless steels[4] find use as mould materials where short checking life and excessive oxidation of cast iron parts are so objectionable as to counter-balance the higher initial cost and operating adjustments necessary to the use of the special alloys. Since these mould parts may be used in conjunction with cast iron, the relative expansion of the two materials is important. In general the straight chromium steel, only mildly alloyed for certain properties, appears to meet the mould requirements better than the chrome-nickel stainless steels. The expansion coefficient appears to affect the checking life. The 13 per cent. chrome steel, or the non-austenitic type, is the most useful mould material.

The stainless steels may be obtained as forgings or as castings. The forgings appear to give a longer life than castings, although it must be stated that considerable improvement has been made in the quality of castings. For glass moulds the pressing face must machine without the slightest imperfection. It is unsatisfactory to have to patch up sand holes or to have a segregated structure which will polish unevenly. Patches always show on the glassware, being opened up at the joints by the heat.

Chromium-Plated Moulds[5]

The real advantage of chromium-plated glass mould surfaces is not always understood.[1] The increased resistance to oxidation given to a mould surface is the apparent advantage. The plated iron or mild steel mould does not take the place of stainless steel in its resistance to heat-checking but it does resist the sticking action of hot glass and permits the highest mould operating temperature. Stainless steels, on the other hand, stick to glass at a minimum temperature.

The ability to obtain and to retain a high polish on mould surfaces is an advantage inherent in stainless steels and on chromium-plated surfaces. While the high polish tends to produce better ware finish, it also affects the intimacy of glass contact with metal and affects the sticking of glass to metal adversely as compared with a moderately polished surface. In this connection a cast iron, containing 3 per cent. graphitic carbon by weight, presents a pressing surface containing 10.5 per cent. of exposed graphite which assists in freeing the glass from the mould surface. All of these conditions must be considered in evaluating the relative sticking of glass to mould surfaces.

Paste Blow Moulds

Some thin-walled hollow glass articles such as electric-light bulbs, beakers, flasks, cylinders and chimneys are desired free from mould seams and with a high surface finish approaching that obtained by blowing glass in the air free from metallic mould surface contact. Such shapes may be blown in paste moulds. The glass shapes must be symmetrical to the vertical axis, since a relative rotation of glass and mould is made about that axis during the blowing operation.

The moulds are somewhat similar to hot-iron blow moulds in that they are jointed or split along the vertical axis to form the half round shape of the ware to be blown therein. The inner mould surfaces are coated with a baked-on layer of linseed oil and carbonised cork dust or willow charcoal. Water is used to treat the mould surfaces between blowing operations so that, when the plastic glass blank is blown against the mould surface, steam is generated to form a controlled cushion and chilling medium. The ware formed is free from mould seams, due to the relative rotation of glass and mould, and possesses a good surface lustre.

The operating temperature of paste moulds is not so high as is obtained with hot-iron blow moulds, so that heat-checking is not the cause of failure. The effect of the steam, however, becomes apparent in growth and warping. This warping may be overcome by providing reinforcing ribs on the grey iron moulds or by use of other cast irons less susceptible to the action of steam. A reduction in the silicon and carbon is beneficial with such cast-iron moulds. The use of nickel cast iron or the use of malleable iron moulds will overcome the warping. Since moulds of this type are machined in large numbers by forming tool methods, the ease of machining is relatively important. All castings should be annealed prior to final machining to eliminate warping from casting stress source.

Improved Mould Service

The mould failure by surface heat-checking has been stated to be caused by the alternate heating and forced cooling. The heating by the hot glass cannot be avoided. The severity of the service could be lessened by reducing the frequency of the cycle and by the elimination of the excessive alternate cooling. The lessening of the frequency could be obtained by reduction of the speed of the machine or by increasing the number of moulds, both of which alternatives have serious objections or limitations.

The severity of the alternate cooling can be reduced in several ways. The reduction in machine speed and increasing the number of moulds as previously stated are the more obvious methods, although they are the ones which will meet with the greatest opposition and which can be considered only as a last resort. The use of heavier mould sections or ribbing to increase the natural heat loss by radiation is another method of reducing the forced cooling on the mould face, while properly proportioned mould sections with controlled outside mould cooling is the most promising means of reducing the severity of service.

The reduction in speed of the machine will not be tolerated. In the case of the conventional glass machine, rotating in a horizontal plane, an increase in the number of moulds means an increase in the diameter of the machine and a corresponding crowding at the forehearth or working end of the furnace. Straight line types of machines or those types which present to the furnace one end of an elongated path of mould circuit are more readily adapted to such increases in the number of moulds. Heavy moulds are objectionable, due to the excessive weight of the moving parts and clearances between moulds. Since glassware of different sizes may be made on the same machine, the space between mould holders would eliminate heavy walled moulds, or limit the size of ware to be made on the machine. The use of heavy moulds or an increase in the number of moulds for a given production rate causes an increase in the time required to bring the moulds to operating temperature. Mould kilns are used to preheat moulds in order to lessen the warming up period.

The blowing of cooling air on to hot mould surfaces, as is often performed in the process of cooling moulds, produces a reversal of stress on the mould face, while cooling of the outer mould wall tends to maintain the compression of the mould face. In blowing air on to the mould face, some parts of the surface desired hot may be overcooled, and it is difficult to return the mould to receive a glass charge with a pre-determined surface temperature and a controlled temperature gradient in the mould body. With the latter type of cooling, the flow of heat may occur in two directions in the mould wall in such a manner that, as the heat from the glass tends to travel into the mould body, it is met with a surge from the layer of metal beneath the mould surface.

Experiments conducted with mould plungers which are internally cooled with air or water

(*Concluded on page 504.*)

A Belgian Steelfoundry Sand for Cast Iron

A SINGLE BASE SAND

By COLIN D. ABELL (Consulting Metallurgist)

The following notes of some personal work on a Belgian steelfoundry sand used in England for cast iron may be of interest to foundrymen and others connected with the problems of foundry sands. This sand possesses a peculiar value in the foundry because of its rather special qualities. It is extremely resistant to deterioration when used in cast iron foundry practice, so much so, that less than 5 per cent. of new sand is ordinarily necessary for purposes of reclamation. Its bond strength (about 18-22 lbs. per sq. in.), and permeability (about 70-75 mls. of gas per minute) are very good, but its special property is the nature of the bonding material, the analytical figures of which are given in Table I.

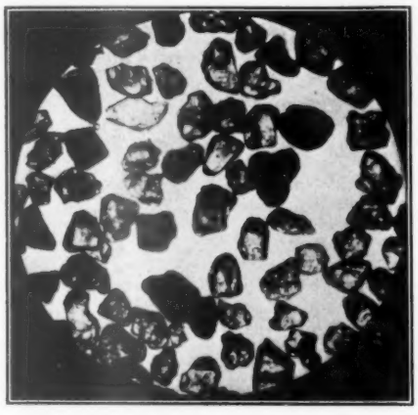

FIG. 1.—SAND GRAINS. × 30.

Another characteristic feature is the remarkable uniformity of the major portion of the sand grains whose average size is about 0.20 to 0.25 mm. The grains are neither rounded nor are they entirely angular and there exists a very small amount of finely comminuted grains of silica which are easily seen under the microscope to be typically angular and show none of that rounded appearance met with in the larger grains. (Figs. 1 and 2.)

TABLE I.—*Analysis of the Bonding Material of the Sand.*

	SiO_2. Per cent.	Al_2O_3. Per cent.	Fe_2O_3. Per cent.	CaO. Per cent.	MgO. Per cent.	H_2O (105°) Per cent.	Loss at 450°. Per cent.
Wet ..	14.37	2.95	15.60	4.01	2.90	52.65	7.37
Dry ..	30.49	6.38	32.98	8.46	6.16	—	15.58

The bonding material contains a number of substances which it is very difficult to determine in exact amounts. The best method of testing the sand appears to be by a graded series of tests with varying strengths of hydrochloric acid. Two facts are immediately obvious when this is done: (*a*) almost the whole of the iron content of the bonding material is soluble in hydrochloric acid of about 0.25N. strength at 100 deg. C., and even in lower strengths; (*b*) examination of the residue shows the presence of small amounts of partially disrupted (exogenetically altered) glassy felspars, together with a few isolated grains of biotite, a magnesian mica mineral common in sands generally; small amounts of tourmaline are also present. Generally, however, the sand is very free from any other mineral but silica sand grains and is free from the troubles encountered in sands with higher proportions of minerals containing easily fusible silicates and alkalis.

The sand grains themselves are not entirely homogeneous, as quite a few grains of glauconite are present, though the amount was not determined. Rough estimates indicate that the quantity is less than 1.5 per cent. The presence of glauconite is interesting, as it shows that this sand has undergone similar geologic processes and is related to the other types of sands used in this respect, although it contains much less of this mineral. Glauconite is not soluble in the strengths of hydrochloric acid used, even in boiling solutions, and remains in the residue.

The bonding material of a moulding sand is the most important factor, in that it determines the extent of (*a*) the bond strength obtained when milled, (*b*) the permeability of the sand according to whether it coats the grains or forms intergranular lumps which are not easily broken up, and (*c*) it determines its resistance towards deterioration in the facing sands where the most desirable characteristics are high permeability, high strength, and good refractoriness.

Traces of barium, titanium, sulphur, and phosphorus are present, and the alkalis were not determined. The sand contains about 10 to 11 per cent. of this clay-like material. It is not possible to determine exactly what the bonding material contains as definite minerals, but halloysite, Al_2O_3. 2 SiO_2.xH_2O is possibly present, together with free silica, which may be partly in an amorphous or suspended state. Hydrated hydroxides of iron in the form of göthite and limonite exist, according to the results of the solubility tests. The lime and magnesia are the residues from the felspars which have been decomposed *in situ*.

Deterioriation Factors

The question now is whether the value of the sand as regards its resistance towards deterioration can be predicted. The writer believes that this is possible.

The small amounts of halloysite, or lithomarge, as it is sometimes called, together with the free silica in a very finely divided state, are in part, if not completely, destroyed in a facing sand and cannot regain their original bonding properties upon the addition of water. They cannot be rehydrated in the ordinary way, and, therefore, are not of much value in the sand for facing purposes. Their proportion is, however, very small even when compared with the bonding material itself. The presence of the relatively high proportion of hydrated iron compounds is of great importance in considering the stability of the facing sand towards high temperatures. In the green sand practice, the quality of the bonding material in the immediate vicinity of the surface of the mould, though not the relatively shallow surface layer, is greatly enhanced by the generation of large amounts of water vapour which enable the bonding material to develop a higher state of hydration and strength. This fact is not generally known, though the writer has actually made tests which show that ordinary milling cannot develop the full strength of these iron-bonded sands and that they must be subjected to a temperature of about 80 to 100 deg. C.

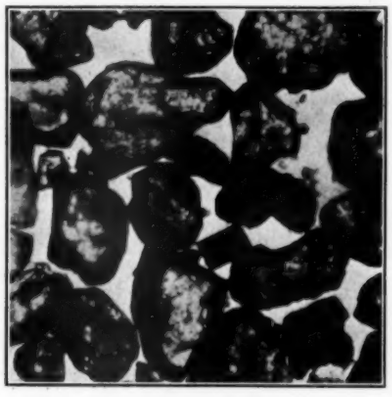

FIG. 2.—SAND GRAINS. × 75.

Fig. 3 shows a scheme of the formulæ of the iron compounds presumed to exist in this bonding material and is based upon certain geological processes and upon data which are well supported by certain other branches of applied chemistry and physical-chemistry, and may be of interest to those of the technical men who are engaged in work on the foundry sands. The formulæ are based upon the laws of isomerism and tautomerism, which are familiar to most chemists who have studied the oxonium compounds.

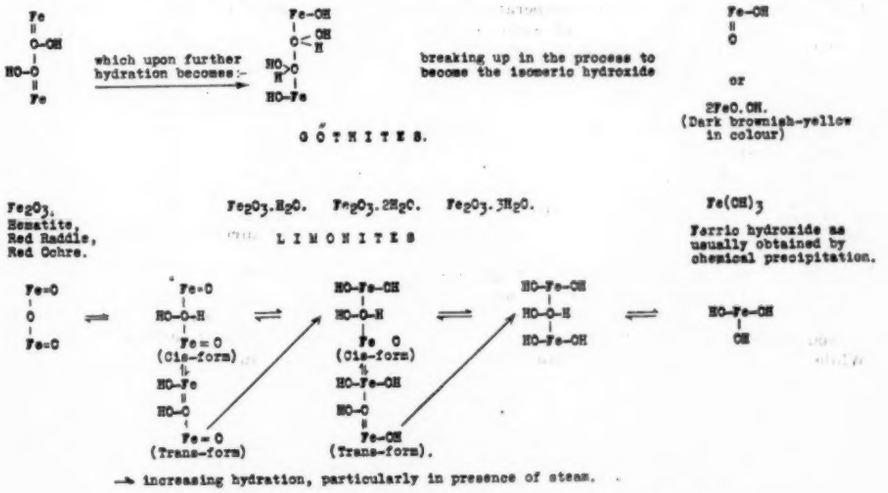

FIG. 3.—SCHEME OF FORMULÆ OF IRON COMPOUNDS IN SAND BOND.

The bonding material of the raw sand contains a large proportion of hydrated iron compounds, which are capable of being further hydrated, and caused to pass into the lyophilic or dispersed

(*Concluded on page 505.*)

Patterns and Their Relation to Moulding Problems*

By S. A. HORTON

A considerable number of Papers has been presented before the various branches of the Institute of British Foundrymen on pattern-making, but the majority have been presented by patternmakers who explained methods of pattern production and various details of the craft. When reading these Papers it is somewhat surprising to find there is no record of the numerous troubles foundrymen encounter when using these patterns to produce satisfactory castings. The purpose of this Paper is, therefore, to discuss details of pattern production which are of primary importance to the moulder and patternmaker.

It should be understood that the various points of pattern production criticised in this Paper are faults which repeatedly occur in the foundry. The patterns in question are received from all parts of the British Isles, and are, therefore, representative of the type of patterns many foundries receive.

There are details in the production of a pattern which the patternmaker should consider before construction of any design is commenced. It is obvious that the following details are of importance: the jointing of the mould; the removal of the pattern from the mould; moulding taper; the weight of metal patterns; the coring of the mould; the correct allowance for metal contraction; the dimensional accuracy and general finish; and casting identification.

All these points should receive serious consideration before the production of a pattern equipment commences as they all affect the resultant casting. When moulding difficulties have been intelligently anticipated by the patternmaker and a satisfactory pattern equipment produced, moulding is considerably simplified.

To simplify moulding means to reduce time spent on the production of each mould, and in these days of mass production, time saved on moulding is of considerable importance. The type of labour now employed in the majority of foundries makes it imperative that a good clean mould be produced every time a pattern is withdrawn from a mould.

The opinion of a great number of patternmakers with whom the author has discussed casting production is that their responsibility ceases directly the pattern equipment passes through the patternshop door; their attitude seems to be that as the pattern equipment has been made as accurately as possible to the drawing, the moulder is responsible for the production of a satisfactory casting.

The purpose of this Paper is not to discuss pattern construction, which is a trade of its own, but to outline several troubles repeatedly noticed on patterns submitted for production which could have been eliminated if more attention were given to the problem of moulding. No doubt the various methods of moulding create their own difficulties; for example, with machine moulding, the pattern equipment is preferred as a two-part job, a pattern submitted as a three-part job, which could be quite satisfactorily produced by another method of moulding, might have to be converted into a two-part job.

It is not desired to create an impression that the points to be raised are applicable to a certain type of moulding; faults are experienced when moulding from patterns by any method, and it is the intention of this Paper to bring several of these to the notice of the patternmaker.

Jointing of the Mould

A moulder can spend a considerable amount of time producing a satisfactory mould joint when working from any type of pattern if necessary provision has not been made by the patternmaker. This operation could be eliminated on 75 per cent. of the patterns submitted to the foundry. It seems to be generally understood that it is the moulder's job to produce the mould joint, but whenever possible it should be produced in the patternshop and not in the foundry. If it has not been possible to produce the pattern in halves, the pattern taper and other details associated with the jointing of the mould should be so formed that the moulder can see exactly where the mould requires jointing.

This statement will, no doubt, bring forth the accusation that when a patternmaker joints a pattern it is never satisfactory to the moulder. This is a difficulty which is easily overcome, because when the patternshop is in doubt, the foundry executive can always be consulted.

An illustration of poor practice is the pattern of cylindrical design which, instead of being made in halves, is made solid. A pattern of this design made in halves is easily mounted on plates for machine moulding. By halves, two exact halves are not necessarily meant, but it should be sectioned in such a manner that the two portions are easily moulded—if there are any parts that will not lift they can be either accommodated by the use of cores or sanction obtained for a slight alteration to the design.

It has been personal experience that the designing departments of engineering firms are interested in the foundryman's troubles, and if moulding difficulties be fully explained, and reasons given why certain alterations to the original design are desired, in the majority of instances such details as loose bosses carried on dovetails or formed by a core would be considerably reduced, because invariably "D" shaped bosses could be incorporated in the design.

It is essential, with the type of labour now available for moulding operations, that whenever possible the mould joint should be formed by the pattern equipment. There are jobs on which this is impossible, but in a foundry producing castings on a competitive basis they must be reduced to the minimum.

Bonnet Pattern.—This pattern is made as a three-part job. It would be simpler to mould if the pattern were split along the vertical centre line, and made as a two-part job for then the joint could be produced by a flat board and there would be a considerable reduction in the moulding cost.

Casing Pattern.—This also is a three-part job, but of a different type. It is a well-made pattern and a considerable amount of thought has been used in its production, but it is not altogether a satisfactory moulding proposition. The pattern is marked to show where the mould joints must be made, and the production of the mould necessitates careful attention to detail. This will take time, and if the moulding time could be reduced by an alteration in the design of the pattern this ought to be done.

It is suggested that this ought to have been a block pattern—the sides having a substantial amount of taper, and the pattern split on the top face. The boss could then be either dowelled on to the pattern or the pattern mounted on a plate, the external shape would then be formed by four cores. The assembly of the cores would be very simple and they would be very easily produced. A pattern made in this manner would not cost much more to produce and the extra cost would more than be saved by the reduction in moulding operations.

Removal of the Pattern from the Mould

The removal of the pattern from the mould is an operation which is necessary in the production of a mould, yet on the majority of loose patterns which are submitted for use in the foundry no provision is made for this. Everybody is familiar with the result of a pattern being used in the foundry without substantial rapping and lifting plates. The moulder is frequently blamed for the rough treatment of such patterns, but it is not entirely his fault when the known precautions have not been taken.

If damaged patterns be returned in an unsightly condition to the owner, a complaint is received of excessively rough usage and inefficient supervision in allowing a moulder to abuse a pattern to such an extent. It is a moulding operation to rap and remove a pattern from the mould, and many loose patterns are supplied without rapping or lifting plates.

There is also the type of lifting plate which is much too small in relation to the size of the pattern, and instead of being flush with the pattern surface, it stands proud and is secured by four ¾-in. screws; no hole is drilled in the pattern to allow the rapping bar to be used efficiently without mutilating the pattern, and invariably, after the third or fourth time, the pattern is rapped, the screws pull out and the moulder resorts to a red hot bar. Even when he exercises special care, the pattern is usually damaged and the cost of the repairs would more than cover the cost of providing substantial rapping plates and correctly placing them flush with the pattern surface.

Excessive rapping can have a very great effect on the size of the finished casting. When recently investigating complaints of excessive weight, casting growth and variation in casting sizes of bulk quantities, it was proved that they were directly due to uneven rapping caused through the moulder using an excessively heavy bar because the rapping hole had become enlarged as no rapping plates had been provided. To prevent a repetition of this trouble, suitable plates were fitted. This, if it does nothing else, will definitely restrict the moulder's choice of rapping bars.

Moulding Taper

Ever since the author has been connected with a foundry the only interpretation of the word taper known to the moulder has been slope, and it is probable that in the past, when castings were sold by weight, the foundry owner also understood taper to mean slope, but those days are gone. With the introduction of

* A Paper read before the East Midlands Branch of the Institute of British Foundrymen, Mr. H. Bunting presiding.

Cast Moulds for the Glass Industry

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and occasionally with liquid metals, have shown that increased plunger life and better pressing conditions may be realised by careful design of the internal cooling area. The same principle of cooling may be applied to moulds with outside cooling, provided the glass machine will accommodate this method of cooling.

General

It may be stated generally that there is much room for improvement in glass mould cooling methods and that few machines and moulds have been designed from the standpoint of best mould life and service, and, further, that it would be possible to obtain better mould life and also better glass production by more attention to the proper co-ordination in machine and mould design with mould cooling methods. Only by such a programme will the glassmaker be able to utilise fully the improved wares which the metallurgical industries have made available.

The author wishes to thank his associates in the development department of the Corning Glass Works, Corning, N.Y., for the guidance and assistance rendered in the pursuit of many of the problems outlined herein and for the many helpful suggestions made in the preparation of this article.

mechanical methods of vibration, pattern taper can be controlled to the satisfaction of both purchaser and foundryman.

Gradually draughtsmen are being educated in the use of moulding taper, but there is a persistent reluctance on the part of the patternmaker to incorporate satisfactory taper in the production of a pattern equipment unless it is shown on the drawing. Half-hearted attempts are sometimes made by sand-papering vertical surfaces to give negligible amounts of taper when the pattern is ready for the foundry.

Why taper appears to be the last consideration is almost beyond comprehension, as the amount of taper required on a vertical surface to give a satisfactory lift is not an unknown quantity, and it should receive consideration when the production of the pattern is discussed. Recently, a foreman patternmaker, discussing with a workman the best method of constructing a certain pattern, dealt with the method of moulding, jointing of the pattern, strength of the pattern, size of coreprint and machining allowance, all of which were intelligently considered. Finally, the workman inquired about the taper, and the foreman replied that they would rub that on when the pattern was finished.

That remark seems to be typical of the amount of consideration usually given to the subject of moulding taper, judging by some of the patterns produced from which satisfactory castings are required. Frequently ribs 3 to 6 in. deep have only $\frac{1}{64}$ in. taper each side. For instance, a pattern on which quite a liberal amount of taper could have been used actually had only $\frac{1}{64}$ in. on each of the two sides. The difficulty the moulder has in withdrawing this pattern from the mould, unless he excessively raps it, is obvious.

This typifies the remarks regarding the absence of sufficient moulding taper. The amount of taper permissible varies with the castings produced, but there is not a single design which is seriously considered as a moulding proposition on which a satisfactory amount of taper could not be allowed.

Weight of Metal Patterns

A good lift is an essential factor in the production of a good mould, and, therefore, the weight of the pattern must be considered, because, if a pattern is easy to lift, it is easily handled and can be more accurately withdrawn from the mould. It has been personal experience that there is always a greater tendency for dimensional inaccuracy when two moulders withdraw a pattern than when one moulder withdraws it alone. It is, therefore, essential for the pattern to be as light as possible, taking into consideration the strength necessary to withstand the service requirements of the foundry.

At the present time, metal patterns are quite frequently supplied, but the choice of metal from which these patterns are made is not as satisfactory as it might be. Some aluminium alloys have proved to be very satisfactory in the foundry, their main disadvantage being that pattern alterations cannot be so readily carried out, but this is a difficulty which can be overcome.

Brass or cast-iron patterns are often made unnecessarily heavy, but when they are effectively lightened, they are quite satisfactory. Frequently they are heavier than the casting they produce, due to the addition of coreprints. Metal patterns are supplied weighing up to 3 cwts., which could be easily reduced to a quarter of this weight if they were lightened. Only a very thin section of metal is necessary apart from a slight strengthening up at the points where lifting and rapping take place.

The remarks on the weight of patterns apply chiefly to the hand moulding section of the foundry, because, if a heavy pattern is supplied for use in the mechanical section, aluminium patterns are prepared and substituted on account of the excessive fatigue repeated handling of such patterns imposes on the moulder.

Coring Up of the Mould

In these days of quantity production machining, when large numbers of castings are machined from predetermined location points, it is imperative that the cored portion of the mould be in correct relation to the moulded portion. To ensure this regularity, the correct type of coreprint is necessary, because it is impossible to maintain the correct position of the core unless there is an ample coreprint.

Considerable difficulty has been experienced from time to time with the coring of differential case castings. The two spherical faced bosses must be correct to within $\frac{1}{32}$ in. of the flange face. The flange is formed by the pattern and moulded, and the two spherical bosses are formed by the core.

Two sets of pattern equipment have been encountered, the first of which has never given the slightest difficulty in maintaining the position of the bosses, because adequate coreprint has been allowed. The core fits freely, and is held firmly in the coreprint, and there is a sufficient area of core covered by the cope to prevent the core lifting when the mould is poured.

A second casting has given considerable trouble, as the core seating is quite inadequate. The core was expected to rest on two portions of a sphere, and there was no provision made to prevent the core lifting, apart from a small centre core. When the pattern was first submitted, two rectangular strips were not attached to the coreprint; these were added because it was possible for the core to be misplaced in a clockwise direction. The strips corrected that error, and also gave an improved core seating, but still a considerable amount of time was lost in coring up this job, as every core had to be set with a core gauge, and every casting to be checked at the inspection tables to prove if the moulder was using the core gauge.

All this extra work could have been eliminated if the type of coreprint associated with the first pattern had been used. It is of interest to know that the first pattern was made in the patternshop of a firm who have their own foundry, and no doubt the foreman patternmaker has learnt from experience how necessary it is when producing this type of casting to have a good core location.

Another trouble experienced is with the core, which is only supported at one end. Usually, just sufficient print is allowed to locate the core, and, when in position, the portion in the mould is considerably greater than the portion in the coreprint, with the result that the correct metal section around the core has to be maintained by using chaplets.

A personal thought is that it is preferable to have a print at least as long as the core protrudes into the casting to eliminate the use of chaplets. The extra print necessitates extra moulding box room, but it has been the author's experience that a more satisfactory casting is produced when using a balanced core than when using chaplets. The extra timber necessary is negligible when a more satisfactory casting is produced. These remarks only apply to a certain type of casting, but this trouble is repeatedly encountered.

Another problem is the pattern on which a round core protrudes into the mould; no corebox is supplied to give the correct length of the core. A mark is painted on the pattern, and the moulder is expected to mark the mould, cut a core to the correct length, and place it in the correct position in the mould.

Castings have been rejected because the length of the core was not within $\frac{1}{16}$ in. of drawing dimension, and this kind of pattern was supplied to produce the casting.

A T-shaped type of pattern illustrates a core difficulty very similar to the example just mentioned. The T-shaped core is located by a print at the base of the vertical portion, and, when in position in the mould, the T is horizontal. The width of the print is not sufficient to balance the weight of core that protrudes into the mould; therefore, chaplets are essential to ensure the correct section of metal around the core.

If prints the same shape as the core had been placed at each end of the pattern, the assembly of the core would have been simplified, and there would then have been no necessity to use chaplets.

Frequently the method of core location causes considerable difficulty. By core location is meant the type of setting strip either added to or cut away from the coreprint, which controls the position of the core in relation to the mould.

The author's firm produces a considerable number of castings for the motor industry, and invariably it is the internal portion of the casting on which the majority of the machining is carried out, and it has been their experience that machining locations are usually taken from some portion of the casting formed by the pattern; therefore, they have very carefully investigated the matter of core location.

Unless the moulder is able to see quite clearly the exact position of the location while he is coring up the mould, the location is not satisfactory; it must be understood that on the castings in question the position of the core must be controlled with limits of plus or minus $\frac{1}{32}$ in.

(To be concluded.)

A Belgian Steelfoundry Sand for Cast Iron

(Concluded from page 503.)

state. A suitable process of milling (*a*) develops the bond by accelerating the adsorption of water, and (*b*) causes the dispersed and heavily hydrated iron compounds to become rapidly coated on the grains of sand. In its original state the iron compounds are partly present as göthite and partly as limonite.

There are several probable reactions which take place upon the burning of the facing sand in the mould, viz.:—(*a*) the inter-molecular change, $2FeO + 2Fe_2O_3 \rightleftharpoons 2Fe_3O_4$, which is reversible at about 500 deg. C., and depends upon the concentrations of the carbon dioxide and carbon monoxide formed by the combustion of the coal- or coke-dust used and other organic matter present, in the presence of the steam produced; (*b*) the reversible reaction of oxidation of the ferroso-ferric oxide: $2Fe_2O_3 + 2FeO + O_2 \rightleftharpoons 2Fe_2O_3$; so that the production of ferric oxide and ferroso-ferric oxide upon the surface of the grains of sand is accounted for satisfactorily: (*c*) dehydration of the partially or fully hydrated göthite and limonite mineral matter on the surface of the grains leads to the formation of a mixture of ferrous and ferric oxides. The presence of steam, as in green-sand work, helps materially in preventing an excess of ferric oxide being formed and the ferrous oxide produced may be rehydrated quite easily. Such is not the case with true clay substances such as kaolin, halloysite, lithomarge, ball-clay, Fuller's earth, etc. Certain highly dispersed clay-like materials also suffer more severely than do the iron-bonded clays, and although they can be rehydrated to a greater extent than ordinary clays, not to the extent possible with the ones similarly constituted to those now considered.

Something like 30 to 40 times the amount of these other clays must be used in reclaiming the old facing sand as against the iron-bonded sands which only require from 5 to 8 per cent. of new sand (not the more costly clay itself). This new sand contains sufficient clay matter to renew the physical properties of the foundry sand and the actual amount varies slightly according to the quality of the sand in so far as it contains varying quantities of soluble iron compounds under certain conditions.

In conclusion, it may be stated that it is necessary to make further researches into the causes of these really remarkable characteristics, especially since the presence of insoluble iron compounds is so detrimental to the usual run of foundry facing sands.

New Works of the Wellingborough Iron Company, Limited

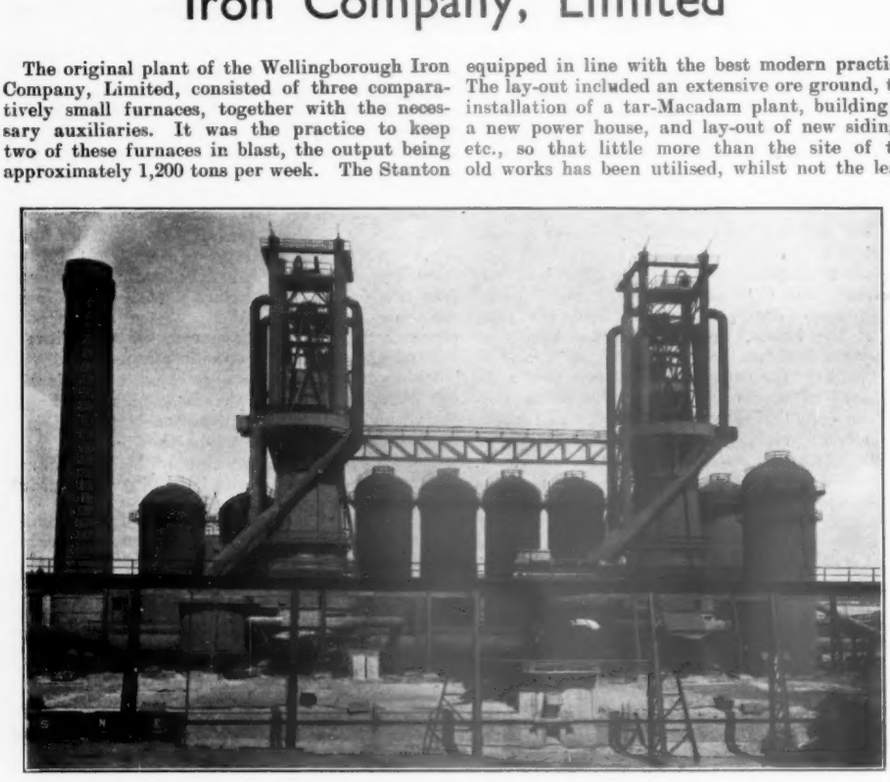
The original plant of the Wellingborough Iron Company, Limited, consisted of three comparatively small furnaces, together with the necessary auxiliaries. It was the practice to keep two of these furnaces in blast, the output being approximately 1,200 tons per week. The Stanton Ironworks Company, Limited, became interested in the Wellingborough Works in 1932, and the question of reconstruction was immediately considered. It was determined that any form of reconstruction, as generally understood, could not be made an economic proposition, and it was therefore determined to rebuild the works entirely.

The scheme recently completed provided for dismantling the old furnaces and erecting in their stead two furnaces which could be equipped in line with the best modern practice. The lay-out included an extensive ore ground, the installation of a tar-Macadam plant, building of a new power house, and lay-out of new sidings, etc., so that little more than the site of the old works has been utilised, whilst not the least difficult part of the scheme has been the making up of the ground for the accommodation of the new plant and its auxiliaries.

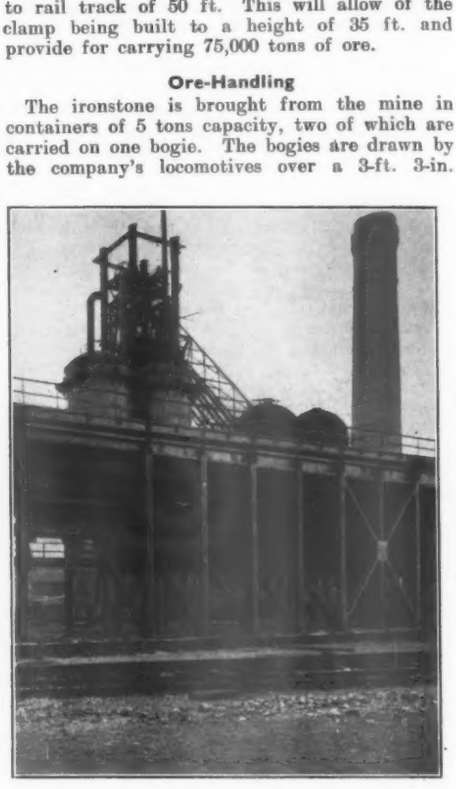
The works are, of course, situated in the heart of the Northamptonshire orefields, and are adjacent to the extensive beds of ore owned by the Wellingborough Company. They are distant some 64 miles from London by the L.M. & S. main line. The sidings connecting up with the railway provide for standage of 300 wagons on the incoming side and 70 wagons on the outgoing side. The ore is calcined in a continuous clamp, the site laid out for this being 750 ft. long by 130 ft. wide. It is spanned by a Goliath crane, with a height from bogie track to rail track of 50 ft. This will allow of the clamp being built to a height of 35 ft. and provide for carrying 75,000 tons of ore.

Ore-Handling

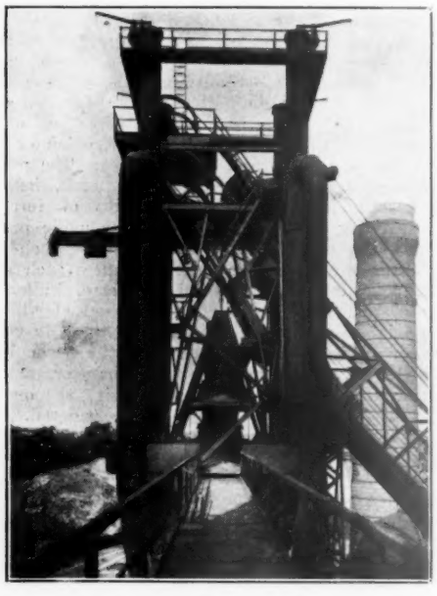
The ironstone is brought from the mine in containers of 5 tons capacity, two of which are carried on one bogie. The bogies are drawn by the company's locomotives over a 3-ft. 3-in. gauge track to the sidings alongside the calcining clamp. Immediately prior to reaching the clamp, the bogies pass beneath a coal hoist, from which the predetermined quantity of coal is automatically discharged into each of the containers. The Goliath crane is equipped with two cabins, from one of which the lifting gear is operated to pick up and discharge the ore from the containers on to the clamp. The second cabin is for the control of the grab for loading the calcined ore to the wagons for delivery to the bunkers.



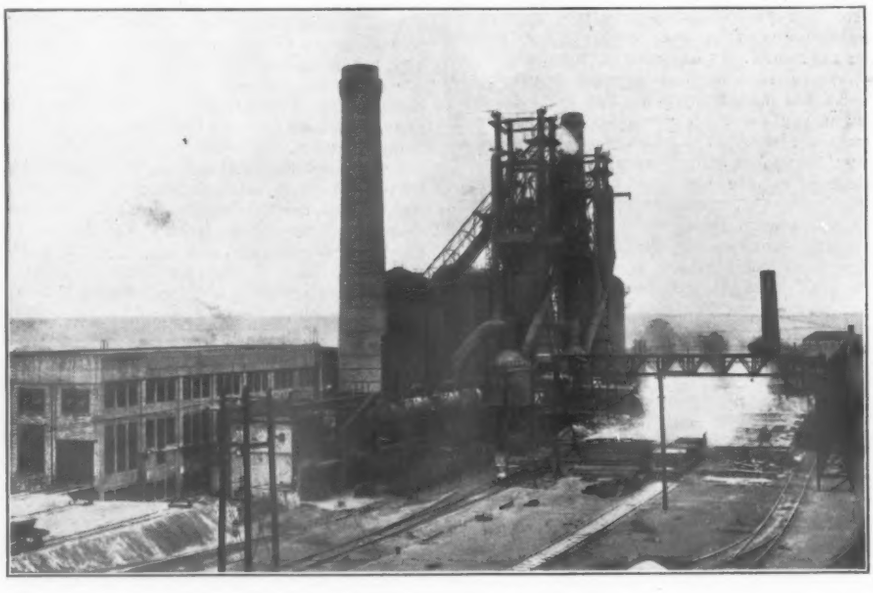
GENERAL VIEW OF BLAST-FURNACE PLANT.



PART VIEW OF FURNACE BUNKERS.



VIEW OF FURNACE TOP.



VIEW OF FURNACES WITH POWER HOUSE ON THE LEFT.

The wagons containing the ore and coke, travel up a ramp to above the bunkers, into which they are bottom discharged, and the empty wagons are returned to the sidings by a gravity drop. There are 11 ore bunkers, of steel construction, built by the Pearson & Knowles Company. They each have a capacity of 150 tons and are placed immediately in front of the furnace hoist. The shutes are fitted with discharge doors operated by pneumatic cylinders. The ore is discharged into electrically-driven lorry cars, which are provided with weighers for automatically weighing the burden. The cars bottom-discharge to the furnace skip. There are two coke bunkers, and these discharge direct into the skip over a Fraser & Chalmers automatic coke screen, which is placed immediately above the skip pit.

Features of Blast Furnaces

Regarding the blast furnaces, they were built by Head, Wrightson & Company, Limited, and are substantially the same as the furnaces built by the same company for the Stanton Ironworks Company, which have previously been described in the technical press. At the same time, it may be interesting if we again briefly refer to the salient features.

Each blast furnace has a hearth of 12 ft. 6 in., bosh 19 ft. and throat 13 ft. 3 in. The bells are 9-ft. dia., and the furnace is 75 ft. high to

EMPTY WAGON DROP FROM ORE BUNKERS.

the charging level. The circular hot-blast main is 3 ft. 6 in. inside diameter, each main being connected to the hot blast by two inlet branches, each having a hot-blast valve to enable the furnace to be isolated. Eight sets of cast-iron tuyere pipes are fixed to the branches on each hot-blast main, fitted with swivel joints, sight holes, doors, belly pipes and connections, and are controlled by the valves on the inlet to the mains. Copper tuyeres are fitted in copper coolers, which are a machined fit inside the water-cooled housings on the hearth jacket. The whole of the cooling water is supplied by circular cast-iron mains suspended from the bosh casings.

A mud gun is suspended by a bogie running inside a traverser, which in turn is carried by a swinging jib operated by two single-acting pneumatic cylinders. The first of these swings the jib with its gun from the stowed position to the front of the tapping hole, in which position the jib is automatically locked, the remaining portion of the stroke of the cylinder being used to advance the gun into the firing position. The maintenance of pressure in the cylinder holds the gun in position during firing. The second cylinder is used for withdrawing, slewing and stowing the gun.

Downcomers, Dust Catchers, and Furnace Top

The gas is taken from each furnace by four vertical tubes, 3-ft. dia., which are of sufficient height for either to be used as a candle. From the sides of these vertical tubes, about 20 ft. up, downcomers 3 ft. in dia. are led down

GOLIATH CRANE DISCHARGING IRONSTONE ON TO THE CALCINING CLAMP.

the sides of the furnace in pairs, each pair being merged into one tube, 4 ft. 6 in. dia., which are led to the dome of the dust-catcher. This is 20-ft. dia., fitted with a butterfly valve and four explosion doors on its dome and dust-outlet valve at the bottom. The gas-connection boxes are 6-ft. dia., with 6-ft. dia. connections to the main gas tubes.

The furnace top is of the double-bell and revolving-distributor type. The main hopper is supported on a seating ring on the furnace casing, having a mild-steel conical cover bolted to its top flange. This cover is provided with explosion doors, also a gas seal at the top of the cone for the revolving distributor. The bell for the main hopper is of cast steel, and is suspended from the bell beam by means of a rod and flat-link chain, giving a vertical movement of the bell.

The revolving distributor is 5 ft. dia., with a gas seal at the lower end, which engages with the one on the conical cover and vertical and horizontal rollers and roller paths at the upper end. The distributor is rotated through gearing which is motor driven. The distributor is closed by the small bell suspended from two bell beams by means of a tube encircling the main bell rod. All the bell beams are carried on a fixed steel superstructure. The furnace is charged with a double-skip hoist. The skip cars are each of a capacity of about 140 cub. ft., and are hoisted by twin ropes with equalising gear.

Control Equipment

Contactor control gear is provided for the control of the skip hoist, distributor and bell-operating mechanism, and is designed to give complete automatic control of the hoist, distributor and bell operations through a push-bottom operated by the scale-car attendant.

The distributor drive is arranged to take three skips with the distributor stationary; three skips revolved 60 deg., three skips 120 deg., three skips 180 deg., three skips 240 deg., and three skips 300 deg. The sequence of operations is as follows: Assuming the skip car is full, the operator presses the push-button, and the skip ascends and is brought to rest at the furnace top by means of limit switches operated by the control gear in the machinery house. After an interval the skip commences the return journey, and in so doing operates a limit switch which energises the solenoid at the master controller for the distributor and bell motors. The movement of the distributor is controlled by a secondary controller, and as it comes to rest, it starts up the small bell motor, which discharges into the main hopper and closes the small bell again. Before coming to rest, the motor energises the master controller so that, as soon as

VIEW IN POWER HOUSE SHOWING TURBO-BLOWER AND TURBO-ALTERNATOR.

its operation is complete, the scale-car attendant can again start the cycle.

The bell motors are so arranged that the small bell opens after every skip, and the large bell after every third skip, the controls being interlocked so that only one bell can be open at a time. In the event of any obstruction preventing either bell closing properly, the bell automatically opens again to its full stroke, and will continue to open and close until the obstruction clears itself.

Two test rods on the top of the furnace are connected to a pneumatic ram situated in the machinery house, which in turn is electrically operated once during each cycle. The rods are timed to withdraw just prior to the operation of the main bell and, after this has closed, to lower automatically and indicate to the scale-car attendant the height of the burden. It may be noted that the stoves are provided with Marley's patent chimney valve and gas burners.

The No. 1 furnace was blown in on March 17, 1935, for the production of foundry irons. As the year advanced, it became increasingly difficult to find a market for the iron, and the question of putting the furnace out was considered; however, a better alternative presented itself, and in the November of 1935 the furnace was put on to basic iron. The No. 2 furnace was blown in on basic iron on January 17 of this year and continued to make until early June. With the improvement in trade the No. 1 furnace returned to the production of foundry irons, for which there is now a good and apparently a widening market. The furnaces were each designed to make 1,200 tons per week; as a matter of fact for several weeks the output from the No. 1 furnace exceeded 1,300 tons per week, the maximum output being 1,360 tons in the week.

The pig bed, with a span of 90 ft., is served by a Vaughan 7½-ton electric crane. The pig breaker is by the Brightside Foundry & Engineering Company, Limited.

Tar-Macadam Plant

The slag is tapped into Dewhurst ladles, which are tipped on the cooling ground adjacent to the tar-Macadam plant. The slag-treatment plant is served by a Vaughan 7½-ton crane. The breaker is by Goodwin, Barsby & Company, Limited. The broken slag is raised by a Bagshawe elevator discharging on to a Fraser & Chalmers vibratory screen which delivers into hoppers; from these the required grade is delivered to a Hiscox mixer, from which it is discharged direct into railway wagons or lorries, as the case may be.

Power House

The power house is a lofty building 140 ft. by 46 ft. 6 in., built in reinforced concrete to the designs of The British Reinforced Concrete Company, by William Perks & Son. A tank is carried on the roof which has a storage capacity of 250,000 galls. of water used for cooling duties, and is served by two centrifugal pumps by the Harland Engineering Company, Limited, each of a capacity of 250,000 galls. per hr.

The blowing plant consists of two Fraser & Chalmers turbo-blowers, each of a capacity of 28,000 cub. ft. at 12 lbs. per sq. in. One of the old blowers by the English Electric Company, Limited, which works at a lower pressure, acts as a standby. The generating plant comprises an English Electric Company's turbo-generator of 1,500 kw., 3,300 volts, three-phase, and a Belliss-English Electric Company combined set of 500 kw.

SPANNAGEL, LIMITED, is a new company recently registered in this country, with offices at 13, Rood Lane, London, E.C.3. The object of this concern is to market specialised plant and machinery for the heavy steel and metal industries as supplied by Gütehoffnungshuette Oberhausen A.-G., Sterkrade, Düsseldorf (formerly Haniel & Lueg), and Schloemann A.-G., Düsseldorf. Mr. H. Spannagel, who is managing director, has been for many years with the H.H., and is well known in this country.

Some Impressions of Industry in the U.S.S.R.

On December 2, Mr. W. T. Griffiths, M.Sc., gave a lecture to a joint meeting of the London Branch of the Institute of British Foundrymen and the London Local Section of the Institute of Metals on "Some Impressions of Industry in the U.S.S.R."

Mr. Griffiths emphasised that his lecture was based upon impressions received during a visit to Russia of a month's duration, the time being spent largely in Moscow, Leningrad and the surrounding districts. He wished it to be understood that these were only impressions received during a short visit and that, therefore, they might be inaccurate. He had hoped, however, that people would be interested in the opinions he had formed.

Before dealing with the situation to-day he gave a brief account of industry as he understood it was in pre-war days and the various changes that had taken place during the war, revolution and post-revolution periods. The present period was initiated in 1928 with the commencement of the first Five Years Plan. This was the first attempt to bring the whole of the industrial activities of the country under the immediate direct control of the Government, and aimed at making the U.S.S.R. quite independent of outside countries. Mr. Griffiths showed the progress that had been made during the years between 1928 and 1936, and pointed out that whatever one might think of the methods that had been adopted one was bound to feel some admiration for the measure of success which had been achieved.

The lecturer next outlined his impressions of the methods which had been developed for centralising the control of industry under the various Commissariats and emphasised the differences which existed between these methods and those in the so-called capitalistic countries. He dealt with the difficulties that had naturally arisen owing to the shortage of individuals with the necessary technical and administrative experience required in the vast organisations which had had to be set up, and the degree of inertia which appears inherent in bureaucratic establishments. He was, however, impressed with the degree of perfection which had been arrived at and with the ability of the directing staff with whom he came in contact.

Research Activities

An account was given of those aspects of state-organised research which came to the lecturer's notice. Under the various Commissariats numerous large research institutes had been established, some doing fundamental work of general application and some being associated with one particular branch of industry. Research was also carried on in the universities and teaching institutes, while naturally some was also done in the many very fine, well-equipped laboratories attached to works.

In order to meet the undoubted need for technically trained people a country-wide scheme of technical education had been developed under the various Commissariats. It was too much to expect that more than quite a small percentage of the thousands of students passing through the universities and technical colleges would benefit to the full from the training received, but undoubtedly the wide-spread technical knowledge thus imparted would be of service to industry, while the opportunities so provided to everybody for education should tend to ensure that the more intelligent members of the community would not fail to be of use owing to lack of knowledge. The system developed also allowed of the more brilliant individuals being diverted to work where best use could be made of their ability. The possibilities of "sandwich" courses and of giving an individual special training for the particular industry to which he was going were of special interest.

Technical education was not only confined to young people or those destined for staff appointments. It was also open to youths and workmen in the works, the school in some cases being in the plant itself. The lecturer outlined the various ways in which this works' educational system was organised.

Technical Control

To assist technical control in the works, the research being carried on, and the technical training, country-wide organisations have been established for the distribution of technical information and Mr. Griffiths gave a brief account of the means by which an individual in an outlying distant works could be kept up to date in regard to information published on his own subject and have assistance in his problems from all research organisations and works in the Union interested in similar questions.

Turning to labour aspects, the lecturer referred to the various methods which had been adopted to stimulate output and gave some account of the present position of the work-people as it appeared to him. There seems no doubt that while unemployment does not exist, the average standard of living in the U.S.S.R. is still far below that in most other modern countries. It also seems clear, however, that the standard is improving, although he could hazard no guess as to when it would approach that of the more advanced industrial nations.

The Future

It was not easy for an outsider, on a short visit, fully to assess the position, particularly as the weekly wage of a worker is only a part of his remuneration, account having to be taken of free medical service, provision of living accommodation at a relatively low rental, holidays with pay, and possibilities of reward by free accommodation in rest homes, low priced theatre tickets, etc. As far as the lecturer's observation went, most people in the towns appeared to have sufficient food but there was a definite lack of variety and a shortage of anything but the absolute essentials of life. Living accommodation too is still appallingly inadequate.

It seemed to the lecturer that the real testing time for the U.S.S.R. was coming in the next decade. Up to the present industry had admittedly been developed largely by the importation of foreign machinery and equipment and by the utilisation of foreign technical aid. Now Russia proposed rapidly to reduce her import of finished goods, to make her own machinery and to rely on her own technicians. Though he had the impression that, provided no major disturbance such as war intervened, Russia would gradually convert herself into a practically self-sufficient nation, with a large self-contained industry, but this was only an impression and he did not feel justified in drawing this conclusion at all definitely.

The meeting which was presided over by Mr. V. Delport, created a record attendance for a London joint meeting of the two societies.

Schneider Concern's Report

The report of Schneider et Cie (Le Creusot), the French armaments firm, which does not give full details of the trading position, shows that a net profit of 20,190,000 fcs. was made in the year ended April 30 last. A dividend of 20 per cent. has been declared on the 400 fcs. shares. This is the third year that the declared profits have totalled slightly over 20,000,000 fcs. per annum, a sum just sufficient to pay the declared 20 per cent. dividend. In 1932/33, a dividend of 25 per cent. was paid out of a net profit of 25,400,000 fcs. It appears that the profits are only declared to an amount required to pay dividends. The share capital is 100,000,000 fcs., and the reserves total 244,730,000 fcs. The value of plant, etc., continues to be returned at 104,000,000 fcs. each year, indicating considerable hidden reserves.

Making a Large Turbo-Alternator Stator Yoke Pattern

By J. R. MOORHOUSE

The alternative to building up large yokes for powers as high as 60,000 k.v.a. by means of arc welding, is to have them made in one or two pieces in cast iron. Figs. 1 and 2 outline a design common to these high powers with the pole pieces X made the entire length of the casting. Owing to the size and weight of these

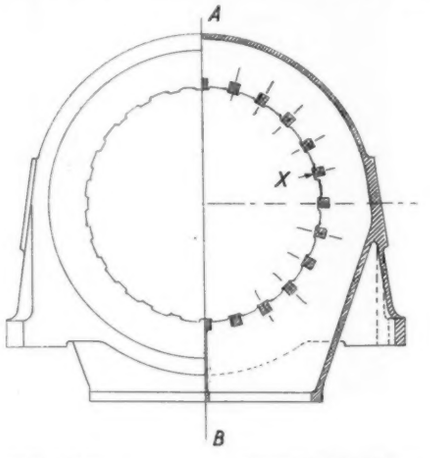


FIG. 1.—END AND SECTIONAL ELEVATION OF A YOKE CASTING.

yokes, great care is necessary in accurately laying out the job, and in determining the method of assembling the cores to facilitate easy moulding.

For this particular casting, the mould is constructed partly in loam, and cores are enclosed to form the feet and vent box. This practice, however, is not always followed, as it is sometimes preferred to set the actual foot pattern and vent box parts in the mould, and complete the whole mould in loam. This is a question of foundry procedure, and will vary according to foundry facilities and the individual opinions of foundry foremen.

It will be noticed that in Fig. 1, showing a part end and part sectional end elevation, and in Fig. 2, showing a part side and part sectional side elevation, there are 24 pole pieces bound together by five ribs, enclosed in a casing that make a very light casting compared to its size.

The method of moulding, and the assembling of the cores is shown in Figs. 3 and 4, and $\frac{1}{10}$ in. per ft. is allowed for contraction and $\frac{3}{8}$ in. for machining was called for. An additional $\frac{3}{8}$ in. is allowed on the top face in the mould.

The mould is struck up in loam to a point determined by the radius R, to meet the two foot cores H. These cores may be set by template on the base, or located by prints fixed in the mould, to suit the moulder, and the tackle made. The two cores G are made to form the inside shape of the feet, and determine the outside dimensions of the vent box sides. They are located in the mould, by means of a core print fixed in the foot core box, and the cores K laid on the base of the mould. These form the outside shape of the end of the vent box, and outline the facing on the ends of the yoke. The two cores F take out the inside of the vent box, and are located by a print built in the mould. The ribs in these cores come in line with those of the pole centre cores E.

To complete the centre, twelve cores are required with two pole pieces in each core, two halves at the joint of the cores, and the other through the centre. All cores are checked and tested by template, before placing in position on the mould base, and any irregularities are corrected to ensure a perfect division of the circle.

Core Details

The centre core box is shown in Fig. 5. This is stoutly built and held together by means of bolts at O securing the ends P to the sides of the core box. These ends are made to maintain the width of the box on the outer diameter $\frac{1}{4}$ in. less than the even circle division, for reasons of adjustment in assembling the cores, and for any distortion that may occur when drying or handling cores of this type.

The pole piece J is drawn through the end of the core box, and to facilitate the removal from the core, a taper of $\frac{1}{8}$ in. each side is allowed in the length of it. A hoop iron I is secured to the ends by bolts R to allow the hook to have a good hold, as the resistance in a bar of this length is considerable. The ribs L are laid out accurately and checked to ensure a correct match when the cores are assembled, then let into the sides and keyed to prevent warping. Lifting irons K, fixed flush with the rib face, are required for lifting these ribs from the core. It will be observed from Fig. 3 that the shape of each centre core is not the same, and change pieces are required to be fixed on the strickled face and filled up to agree with the lay-out.

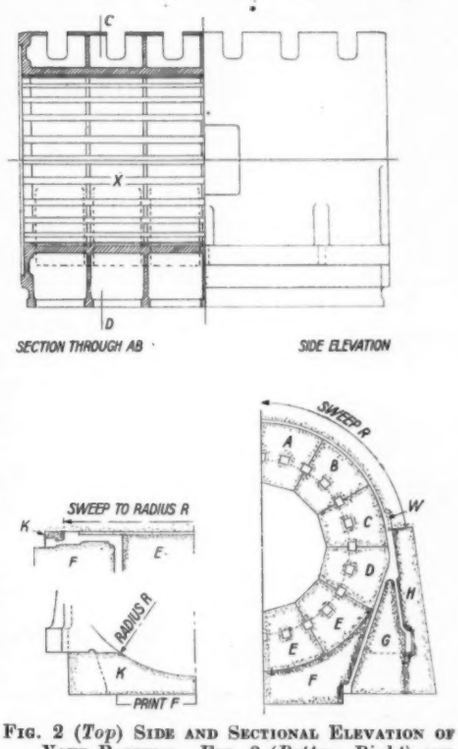


FIG. 2 (*Top*) SIDE AND SECTIONAL ELEVATION OF YOKE PATTERN. FIG. 3 (*Bottom Right*) AND FIG. 4 (*Bottom Left*) METHOD OF MOULDING AND ASSEMBLING CORES.

Two cores will have two extension segments A, made to cut through the metal thickness in the casing. These are set in position by pins M, and after use for one opening, are re-set, and likewise used throughout the length of the box for the six openings. Two cores, one right hand and one left hand, will be required for cores B, with the use of extension segments A, as previously described, but with the addition of parts X,

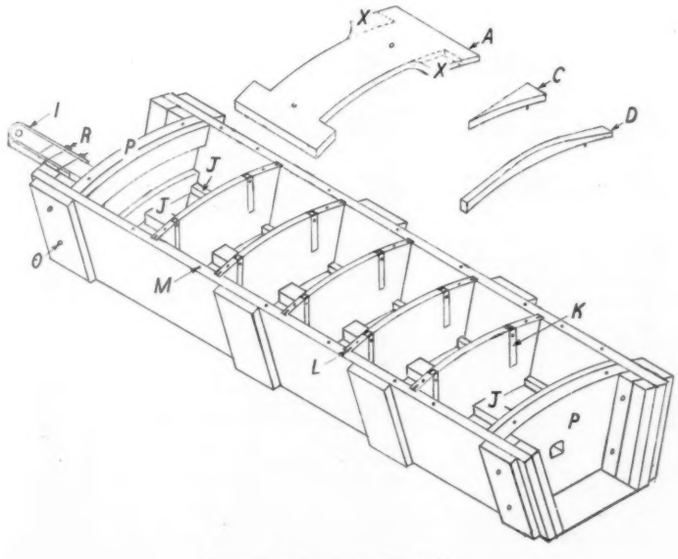


FIG. 5.—CENTRAL CORE BOX.

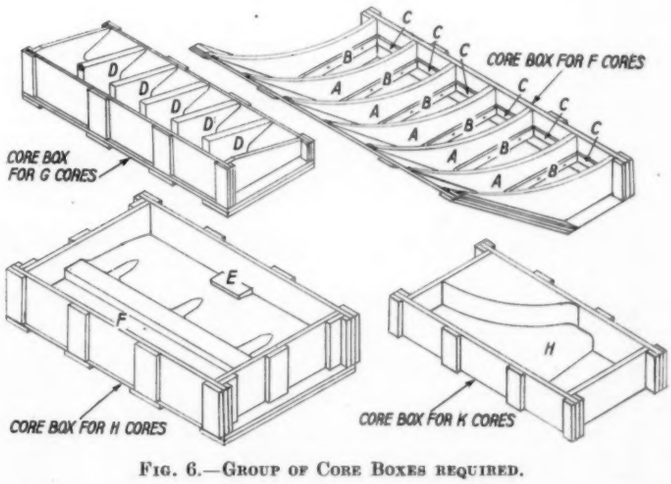


FIG. 6.—GROUP OF CORE BOXES REQUIRED.

to close in the six openings required in the casting. The two cores, one right hand and left hand, will have the use of seven extension parts similar to C, for C cores, and these two cores will also use seven extension parts as D, for D cores. There will be four cores without extensions for E cores. This completes the twelve cores that make up the centre of the yoke casting.

The core boxes required for making the cores for completing the mould are shown in Fig. 6. The core box H makes the cores for forming the feet, and reference to Fig. 3 will show how this is made to match the struck up portion of the mould. One will be made right handed and the other left handed. If it be preferred to run the casting from the bottom flange of the foot, a runner is fixed in the core box immediately over the print F.

Two cores will be required from the core box G, one right hand and the other left hand; the blocks D are dowelled on the bottom board to positions permitting this change over. Two cores, one right handed and the other left handed, from the core box F, with the ribs A and facings B and C dowelled to allow for the change, and four cores, two right hand and two left hand, will be required out of the core box K to complete the mould.

The sweeps, prints and templates have not been shown, but these follow out the usual shop practice. A further reference to the drawings will clearly outline the principle of making these large yokes, and from the description given the practical patternmaker can fill in the lesser details.

Refractory Concrete

A new refractory concrete which is being manufactured by Lafarge Aluminous Cement Company, Limited, High Holborn, London, is claimed to possess all the properties of ordinary aluminous cement concrete such as rapid hardening and immunity from corrosion by sulphates. It is also claimed to possess a high degree of refractoriness and a low conductivity. The concrete is ready for use being strong and hard in 24 hrs. It is stable under load up to 1,300 deg. C., has a melting point of about 1,450 deg. C., and can be used up to 1,600 deg. C. with a chrome or chrome-magnesia aggregate. It requires no pre-firing and there is no appreciable drying shrinkage. There is no spalling when the material is subjected to violent temperature fluctuations.

The basis of this refractory is Ciment Fondu, and it can be used for concrete as a foundation for furnace structures, or for certain parts of furnace linings. It also provides a good bond for setting firebricks when temperature conditions are insufficient to vitrify ordinary fireclay.

Iron and Steel Institute

The following fixtures have been made for 1937:—

Annual Meeting.—The annual meeting will be held at the Institution of Civil Engineers, Great George Street, London, S.W.1, on Thursday and Friday, April 29 and 30.

Annual Dinner.—The annual dinner will take place at Grosvenor House, London, W.1, on Thursday, April 29, at 7 for 7.30 p.m.

Autumn Meeting.—The autumn meeting will be held during the week ending September 18.

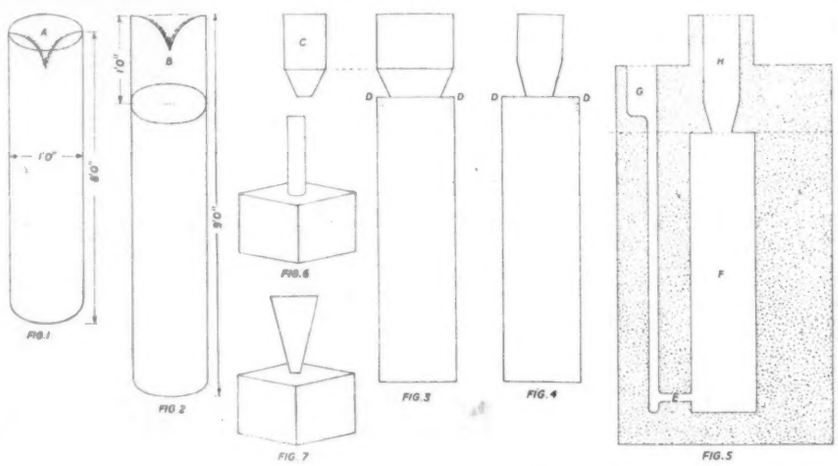
Joint Meeting.—A joint meeting with the Electrodepositors' Technical Society will be held at British Industries House, Marble Arch, W., on Wednesday, January 13, when Mr. D. J. Macnaughton and Mr. W. H. Tait will present a Paper on "The Tinning of Steel Strip by Electro-deposition."

Feeding of Castings

By THOMAS DAVIS

Feeding a casting is often looked upon as being something adjacent to moulding, yet it should be considered one of the most important tasks which a moulder undertakes irrespective of the size of the casting. This operation will be performed more successfully if the fundamentals which make it necessary are thoroughly understood.

The whole process, from the time when the mould is filled with metal until the casting is cold, is divided into two distinct periods; the first is termed shrinkage, and the second contraction. The line of demarkation between these two periods is drawn when the metal has reached freezing point, solidification being terminated by a slight expansion of the metal. This action is not so pronounced in large castings as those of medium size, and it seems most marked in castings which require to be fed. It will be noticed that immediately a feeding rod is withdrawn, the metal wells up slightly in the riser, and this seems to indicate that a slight expansion has occurred. Science applied to foundry practice is giving the practical man new conceptions regarding his trade, but in spite of the many advances that have been—and are being—made in foundry progress, moulders have still to rely, to a large extent, on the assistance of the feeding rod in order to avoid shrinkage holes in large castings.



FIGS. 1 TO 8.—SHOW PROGRESSIVELY THE FEEDING OF A ROLL.

Fig. 1 shows a roll 8 ft. long by 12 in. dia. Assuming that no preparation is made for feeding such a casting, the top, instead of being level and solid, will probably follow a contour similar to that shown at A. It is not necessary to enter into a scientific explanation as to the cause of this phenomenon; the practical man is more concerned with how best to prevent it. Briefly, a gradual shrinkage of the whole volume of the metal occurs until the solidification point is reached. The main purpose in feeding such a casting is to lift the shrinkage shown at A above the level of the casting. There may be differences of opinion regarding the best method to adopt in order to secure this result.

Fig. 2 shows a method of feeding which has much to commend it. The length of the casting is extended 12 in., and this extra portion acts as a "self feeder," and requires no assistance from the feeding rod. In this case the shrinkage is lifted from the point, as shown at A, in Fig. 1 to that of B in Fig. 2. The objection to this method is the extra cost in machining off this extension piece.

Fig. 3 shows another form of riser which has some good points. One advantage in this case is the ease with which the riser is removed from the casting. It will be seen that the riser extends across approximately three-quarters of the diameter of the casting, the thickness being seen at C., and gives facilities for two feeders if desired. The objection to this form of riser is that during the process of feeding the dirt and scum are liable to radiate to the edge of the casting, as shown at D, and if the casting has to be machined, due allowance should be made here by giving a little extra thickness. The actual feeding process is illustrated in Fig. 5.

Another form of riser is shown in Fig. 4; this is, perhaps, the most generally used method. A large round plug, approximately 6 in. dia. and tapered at the bottom, is utilised. The advantages and disadvantages of this method are similar to those described in the last method.

Fig. 5 shows a mould ready for casting. It will be noticed that the riser head H is carried considerably higher than the runner G. This may seem superfluous, but it will be found of great advantage in actual practice. When the in-gate E, leading into the mould F, has reached freezing point, supplies of hot metal can be added to the riser for feeding purposes. By adopting the low runner and high riser method, the pressure of the mould is not unduly increased.

Figs. 6 and 7 show risers for castings of smaller dimensions, but these should be regarded with equal importance. The long straight riser seen in Fig. 6 should never be used on this type of casting, as there is a danger of it freezing before the casting has solidified—particularly if the metal is dull. The tapered riser, as shown in Fig. 7, is much to be preferred, as it increases the volume of feeding metal, without adding to the difficulties of removing the riser from the casting.

These notes are not intended to cover the whole question of feeding castings, but it is hoped that they will draw the attention of the practical man on to a matter which is too often looked upon as a very simple operation in foundry practice.

Statistics of the Iron and Steel Industries

The British Iron and Steel Federation has issued the fifteenth annual volume of the "Statistics of the Iron and Steel Industries," which again shows an expansion on previous issues. New tables have been added and certain existing tables modified to make the statistics as comprehensive as possible. The tariff section has been brought up to date, and contains the latest information available at the time of going to press. District reclassification has been made in the United Kingdom section to bring the statistical classification in line with that adopted by the Federation for electoral purposes. The new volume may be obtained from the Federation, Caxton House, Tothill Street, Westminster, S.W.1. (price 10s. 6d. net, post free).

CUMMING'S BLACKINGS

ARE

THE BEST

Extract from daily report by one of our travellers:—

January 9th, 1936.

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"I shall send on to you every time. Since we adopted your Blacking the skin of our castings has improved by 100 per cent. Our customers were the first to notice it."

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The Week's News in Brief

Trade Talk

THE "DAILY MAIL" IDEAL HOME EXHIBITION will be held at Olympia from March 30 to April 24, next year.

MR. ALAN FINDLAY, general secretary of the United Patternmakers' Association, states that the number of unemployed members registered is 177 and that there are now 69 fewer men at work than a month ago.

SWAN, HUNTER & WIGHAM RICHARDSON, LIMITED, Wallsend-on-Tyne, are to build a 10,000-ton motorship for Newcastle owners. The engines will be supplied by Swan, Hunter's Neptune Works, Newcastle-upon-Tyne.

STIRLING TOWN COUNCIL is considering a scheme to provide in time for the Coronation, a Westminster chime of bells at the Municipal Buildings in Stirling, either by recasting the bells in the old Tolbooth Steeple or by providing new bells.

THE FURNESS SHIPBUILDING COMPANY, LIMITED, Haverton Hill-on-Tees, are to build an 8,000-ton vessel for the United Africa Company, Limited. The triple-expansion machinery will be supplied by the North-Eastern Marine Engineering Company, Limited, of Wallsend.

ORDERS FOR two steamers of 8,500 tons for the British India Steam Navigation Company, Limited, have been placed with William Gray & Company, Limited, West Hartlepool. The engines will be built at the company's Central Marine Engine Works, West Hartlepool.

PRODUCTION OF PIG-IRON in Russia during October was 1,204,700 long tons, as compared with 1,180,300 tons in September, and 1,060,300 tons in October, 1935. Corresponding figures for the production of raw steel were 1,495,000 tons, against 1,345,800 tons and 1,139,100 tons.

JOHN WHITE & SON, of Auchtermuchty, Fifeshire, held their annual social last week. This is one of the oldest foundry concerns in the United Kingdom, and is still controlled by the descendants of the original proprietors. About 130 members of the staff and guests were present.

CLYDESIDE WILL FINISH the year as the busiest shipbuilding centre of Britain, with 63 merchant ships, totalling 630,000 tons, under construction and on order. This excludes the 56,455 tons of naval vessels building on the river. Out of the 63 ships, 33 are liners, 15 cargo boats, and 15 tankers.

THE ADMIRALTY have decided, subject to the settlement of certain points of detail, to entrust the construction of the tender to H.M.S. "Vernon," H.M.S. "Linnett," of the 1936 naval programme, to Ardrossan Dockyard, Limited. The machinery will be constructed by Ferguson Bros. (Port Glasgow), Limited.

A REPORT OF THEIR OPERATIONS in 1936 issued by the English Electric Company, Limited, states that the past year has seen great activity in all departments, and especially gratifying has been the improvement in heavy electrical engineering. Steam turbine generating plant built includes two 40,000-kw. units at 3,000 r.p.m., which will be the largest machines operating at this speed yet to be installed in this country. There has been an improvement in overseas trade with the Empire.

APPLICATIONS FOR THE CONTINUANCE of "A" licences by six Falkirk road-transport companies and one Grangemouth company were granted last week by the Licensing Authority for the South of Scotland Area (Mr. A. Henderson). In his judgment, Mr. Henderson said that, while the railway companies, by their evidence that they carried castings of all classes, showed him that they were capable of doing the work, it was obvious from the evidence of the manufacturers that they thought that, in certain circumstances, road transport was more suited to their requirements and to those of their customers. He accepted the evidence of the manufacturers on this point, and was satisfied that the foundry trade of Scotland would suffer if deprived of the services of road carriers. The railway companies did not satisfy him that it was in the public interest that he should refuse the applications, either as a whole or in part.

MR. JAMES L. RICHMOND, district secretary of the United Patternmakers' Association, died suddenly at Clydebank last week.

Obituary

MR. JOHN LYON WILSON, foreman moulder, employed by James Abernethy & Company, Limited, Ferryhill Foundry, Aberdeen, has died at the age of 62 years.

MR. JOSEPH MARSHALL, who was employed for more than half a century as a patternmaker in the foundry of Smith & Wellstood, Limited, Bonnybridge, died on December 12, aged 85.

THE DEATH OCCURRED, last Sunday, of Mr. Henry Arthur Raine, director and secretary of Raine & Company, Limited, Delta Iron and Steel Works, Derwenthaugh-on-Tyne. He was 69 years of age.

THE DEATH OCCURRED, on December 19, of Mr. Alexander Anderson, late works general manager of the North British Locomotive Company, Limited, Springburn, Glasgow. He retired five years ago after completing 60 years' service with the company.

IT IS PARTICULARLY DISTRESSING to have to record the death of Mr. Ian S. Osborn, a director of Samuel Osborn & Company, Limited, steelfounders, of Sheffield. Last year at this time we were preparing for Press an article by him on the steel-

MR. IAN S. OSBORN.

foundry industry for insertion in the Annual Review Number. He was only thirty-six years of age, but had already established himself as a leader amongst the industrial, social, philanthropic and sporting activities of Sheffield. Mr. Osborn was the eldest son of Mr. Fred. M. Osborn, director of Samuel Osborn & Company, Limited, and chairman of the Board of Sheffield Royal Hospital, and was a grandson of the founder of the firm, the late Mr. Samuel Osborn. He was educated at St. Anselm's, Bakewell, the Ley's School, Cambridge, and Christ's College, Cambridge, where he took an honours degree in engineering. He became an engineering pupil with Davy Bros., Limited, Sheffield, to gain experience in the practical side of engineering work. Subsequently, he joined his father's firm, of which he became a director in 1927. He was associated particularly with the steelfoundry department, acting as personal assistant to Mr. Samuel Osborn, chairman of the company. He was a member of the Institute of British Foundrymen and the Iron and Steel Institute.

MR. JOHN SMELLIE, J.P., of Mossend, died on December 22. Many years ago Mr. Smellie was employed at the Clydesdale Iron and Steel Works of Stewarts and Lloyds, Limited, and later was manager of James Dunlop & Company, Limited's, steelworks at Calderbank. Afterwards he was appointed manager of the Mossend works of William Beardmore & Company, Limited, where during the war period he superintended the large extensions carried out.

Personal

IN CONNECTION with the recent Tercentenary Celebrations of Harvard University, a water-colour painting of Oxford, seen from the top of the Sheldonian Theatre, has been presented to the University by Sir Robert Hadfield.

AS A RESULT of the reorganisation of the directorate of Petters, Limited, Lt.-Col. J. T. C. Moore-Brabazon, M.C., M.P., Mr. W. Craven-Ellis, M.P., Mr. W. A. Phillips, Mr. J. R. Greenwood and Mr. T. A. Macauley have joined the board of directors, whilst Mr. G. B. Petters has resigned.

MR. WILLIAM ROLLAND has been appointed works manager of Hardie & Gordon, Levenbank Foundry, Dumbarton. Mr. Rolland was previously manager of Cyclops Foundry, Glasgow, and when this foundry closed, he joined the staff of Harland & Wolff, Limited, Clyde Foundry, Glasgow.

AFTER 47 YEARS' SERVICE, Mr. James Hunt, director and secretary of J. Samuel White & Company, Limited, shipbuilders and marine engineers, of Cowes, is to retire from the services of the company at the end of the present year. Mr. R. H. Close, A.C.A., assistant secretary, has been appointed secretary to the company in succession to Mr. Hunt.

MR. C. R. HODGSON has been appointed senior resident representative of R. A. Lister & Company, Limited, Dursley, Glos, in Australasia. Mr. Hodgson will have his headquarters in Sydney. Mr. Hodgson will also act as senior resident representative for Blackstone & Company, Limited, of Stamford, Lincs, in which R. A. Lister & Company have a substantial interest.

MR. J. G. PEARCE, director of the British Cast Iron Research Association, has been elected to the Freedom and Livery of the Worshipful Company of Founders. During the past year he has also been elected a member of the Metallurgy Research Board, a member of the Department of Scientific and Industrial Research; chairman of the Main Committee on Cast Iron of the British Standards Institution; member of the Corrosion Committee of the Iron and Steel Institute and Iron and Steel Industrial Research Council; and the honorary adviser and honorary treasurer of the British Foundry School.

Wills

BEGG, JAMES, director of Glenfield & Kennedy, Limited	£195,168
LEGGOTT, R. J., of Bradford and of Harrogate, brassfounder	£36,223
MACLEOD, SIR FREDERICK L., director of Grangemouth Iron Company, Limited, Falkirk	£125,611
BOOTH, JAMES, chairman of Samuel Booth & Company, Limited, brassfounders, etc., Birmingham	£154,047

Forthcoming Events

JANUARY 11.

Iron and Steel Institute:—Joint Meeting with the Cleveland Institution of Engineers. "Constitution of Blast-Furnace Slags in relation to the Manufacture of Pig-Iron," Paper by T. P. Colclough, at the Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, at 7.30 p.m.

Institute of British Foundrymen

JANUARY 6.

London Branch:—Consideration of two Technical Sub-Committee Reports: "Recommendations for Two Leaded Gunmetals," and "Dimensional Tolerances for Castings (with Particular Reference to Malleable Cast Iron)," at the Charing Cross Hotel, London, at 8 p.m.

JANUARY 7.

East Anglian Section:—"Casting of Non-Ferrous Materials," Paper by E. Robson, at Colchester, at 7.30 p.m.

Sheffield Branch:—Joint meeting with the Foundry Trades Technical Society. "Some Foundry Characteristics—Iron, Steel, Brass," Paper by P. Longmuir, D.Met., at the King's Head Hotel, Change Alley, Sheffield, at 7.30 p.m.

JANUARY 9.

Lancashire Branch:—"Mechanical Aids for Increased Foundry Production," Paper by J. Timbrell, at the Engineers' Club, Albert Square, Manchester, at 4 p.m.

Burnley Section:—Annual Social, Nelson House, Burnley, at 7.15 p.m.

Scottish Branch:—"Mechanisation in the Foundry," Paper by N. C. Blythe, at the Royal Technical College, Glasgow, at 4 p.m.

The Institute of Vitreous Enamellers

JANUARY 7.

Northern Section:—"Mechanical Drying as Applied to Vitreous Enamelling," Paper by J. H. Hollows, at the Queen's Hotel, Manchester, at 7.30 p.m.

THE "ROCKET" CORE MAKING MACHINES

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REDUCE COSTS AND MAKE SOUND CASTINGS

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Raw Material Markets

Quiet conditions have ruled this week, owing to the holidays. Prices of hematite have been raised by 12s. 6d. per ton, and the extras on low sulphur and phosphorus qualities have also been increased considerably.

Pig-Iron

MIDDLESBROUGH.—All available supplies are being very carefully distributed in this area, and consumers are given no opportunity of accumulating stocks. Three months' output at least is involved in the disposal of existing contracts. Little relief will be felt by the lighting up of another blast furnace in the near future. The fact that export business is still to be had if required affords some relief to producers, as it has been felt that, with the repeated refusal of business, consumers abroad would transfer their business elsewhere. No. 3 Cleveland G.M.B. is quoted at 81s., delivered Middlesbrough, 83s. elsewhere on the North-East Coast, 84s. to Falkirk, and 87s. per ton delivered Glasgow.

It had long been anticipated that the price of hematite would be advanced by from 10s. to 15s. per ton, and thus, the decision to increase the figure of East Coast mixed numbers by 12s. 6d. to 97s. 6d. per ton, less 5s. rebate, in the Middlesbrough area, 103s. in Sheffield, and 108s. 6d. in Birmingham, occasioned no surprise. Business has been held up for want of some definite indication of the trend of prices for some time past, and only small parcels have been involved in recent transactions. Deliveries are behind schedule, while the current output is not nearly sufficient to satisfy the demand.

LANCASHIRE.—Most consumers of pig-iron in this area are well employed and have excellent prospects for the New Year. In some cases local foundries have covered their requirements as far ahead as September, while nearly all are contracted up to the middle of the year. Offers of Staffordshire and Derbyshire brands of No. 3 foundry iron for delivery to users in the Lancashire price zone are quoted on the basis of 89s. per ton, with Northamptonshire at 87s. 6d., and Derbyshire forge iron at from 84s. to 86s. per ton, according to the class of consumer. Owing to the shortage of supplies prices of hematite are only nominal. These have been raised by 12s. 6d. in the case of English material. For delivery equal to Manchester, West Coast mixed numbers are at 106s. per ton, with 105s. 6d. for East Coast.

MIDLANDS.—Firm conditions continue to prevail in this area and the difficulties in the way of new business have yet to be overcome. Prices are unchanged, Northamptonshire No. 3 being quoted at 83s. 6d. per ton, with Derbyshire and Lincolnshire No. 3 at 86s., delivered Birmingham and Black Country stations. There is a good demand for forge pig-iron at 5s. per ton below the foregoing figures. Northamptonshire iron is under contract up to the end of June, while Derbyshire and other material is specified as far ahead as the autumn. As yet, supplies of Derbyshire iron are plentiful. Heavy engineers, motor-car makers and other establishments continue to have substantial requirements of special irons. Producers claim to have kept up with these so far, but the margin between demand and output is known to be very small. Prices are as follow:—Medium-phosphorus iron, 90s. to 95s., low-phosphorus iron, including Scottish No. 3, 97s. 6d. to 105s.; refined iron, £6 5s. to £7 15s., according to quality. Quotations of hematite have now been raised. Prices are nominal at £5 9s. 6d. for West Coast mixed numbers, and £5 8s. 6d. for East Coast No. 3, delivered to Birmingham and Black Country stations.

SCOTLAND.—There will only be a short delay for the usual repairs this year, as the works cannot afford to lose the time under existing conditions. The last few days of the year showed little decline in the demand for supplies of pig-iron. Although the holiday will result in small stocks being built up at the blast furnaces, these will be rapidly cleared when work is resumed. No. 3 foundry is quoted at 88s. f.o.t. furnaces, with 2s. 6d. extra for No. 1. Prices of No. 3 Cleveland are unchanged at 84s. f.o.t. Falkirk and 87s. f.o.t. Glasgow, with Northamptonshire foundry at 1s. 3d. per ton less. An advance in the price of steel-making irons is announced. Mixed numbers of East Coast and West Coast hematite are now quoted at 98s., less 5s. rebate, delivered Scottish steelworks. Sales can now be made up to the end of next June.

Coke

Business in the foundry-coke market has been restricted to small tonnages recently, as most consumers have already entered into commitments extending over a period of several months. For delivery to Midland stations, best Durham coke is quoted between 42s. 6d. and 45s., with Welsh coke from 39s. 6d. to 54s. per ton.

Steel

Consumers of all steel products continue to experience considerable difficulty in obtaining further supplies. Producers are hard pressed to comply with their contractual commitments, and there is no surplus material after these have been met. Semi-finished steel is well taken up, and orders for prompt delivery cannot be accepted. There is an insistent demand for all descriptions of finished steel, but makers have considerable delivery arrears to overcome, and thus new business is difficult to place at the present time.

Scrap

Prices of imported scrap are rising in the Cleveland area, and, as a result, the demand for home material has become even more insistent. The quotation for heavy steel has advanced to 62s. 6d., but, even at this figure, producers are reluctant to enter into forward contracts. There is a pronounced shortage of heavy machinery metal at 72s. 6d. Good, heavy foundry cast iron is strong at 70s., while makers are demanding higher offers for clean, light cast iron than 53s., which is as far as buyers are prepared to go at the present time. It is considered likely that prices of scrap will advance in the near future in the Midlands. The market is firm, with inquiries received for all descriptions. Heavy steel in furnace sizes is at 55s., while mixed heavy iron and steel in furnace sizes is 53s. 6d. to 55s. Heavy unsheared wrought iron is at 67s. 6d. Heavy machinery metal in cupola sizes is at 72s. 6d., good heavy 70s., and clean light 55s. Short, heavy steel, as used in the foundries, is at 67s. 6d. to 70s. per ton, delivered works. The position on the Scottish market remains very active. Heavy mild-steel scrap is at 57s. 6d., while for heavy basic, or heavy iron and steel scrap mixed, about 5s. per ton less is accepted. Good, heavy, piling wrought-iron scrap remains strong at 70s. to 72s. 6d., while for special quality 3s. to 4s. more is paid. Heavy machinery cast-iron scrap, in pieces not exceeding 1 cwt., is at 72s. 6d. to 73s. 6d., with heavy ordinary cast-iron scrap, to the same specification, at 68s. 6d. per ton, delivered f.o.t. consumers' works.

Metals

Copper.—Activity in this metal was maintained right up to the Christmas holiday, and consumers have been in the market for some substantial tonnages. The domestic price of copper in the United States has been raised by ⅝ cent per lb. to 11⅝ cents, which is the highest level for the last six years. The export price, which has been advanced by a further 17½ points, is now at 11.60 cents, which represents the highest figure on record. These increases have since been followed by advances by copper and brass fabricators and wire and cable manufacturers proportionate to the copper rise. United States producers have been requested to sell for delivery five or six months ahead, but are unwilling to consider any price.

Daily market prices:—

Cash.—Wednesday, £48 2s. 6d. to £48 3s. 9d.; Thursday, £47 18s. 9d. to £48; Monday, £48 15s. to £48 16s. 3d.; Tuesday, £49 3s. 9d. to £49 5s.; Wednesday, £48 10s. to £48 11s. 3d.

Three Months.—Wednesday, £48 7s. 6d. to £48 8s. 9d.; Thursday, £48 5s. to £48 6s. 3d.; Monday, £49 1s. 3d. to £49 2s. 6d.; Tuesday, £49 8s. 9d. to £49 10s.; Wednesday, £48 15s. to £48 16s. 3d.

Tin.—This market has been the quietest of the non-ferrous metals recently, and new buying has not been very substantial. Similar conditions have prevailed on the Continent and in the United States. Consumption generally is reported to have been maintained on a satisfactory level, but doubt still exists as to how supplies will be forthcoming under the existing quota of 100 per cent. Thus, the outlook is uncertain. Siam ratified the new tin restriction agreement at a private session of the Siamese Assembly held on Monday at Bangkok. The decision was unanimous. The apparent world consumption of tin in the twelve months ended October last totalled 153,709 tons, an increase of 13,925 tons over the total for the preceding twelve months. World production increased by 36,200 tons to 167,000 tons.

Metal Exchange quotations were as follow:—

Cash.—Wednesday, £232 to £232 5s.; Thursday, £231 15s. to £232; Monday, £233 10s. to £234; Tuesday, £235 10s. to £235 15s.; Wednesday, £233 to £233 10s.

Three Months.—Wednesday, £232 5s. to £232 10s.; Thursday, £232 to £232 5s.; Monday, £233 15s. to £234; Tuesday, £236 to £236 5s.; Wednesday, £233 15s. to £233 17s. 6d.

Spelter.—Consumption of this metal is believed to have expanded recently, and some heavy tonnages have been taken up. The output problem remains a source of anxiety to the market, as producers appear to be quite unable to come to any form of agreement on this question. At the present time production is far in excess of requirements.

Official quotations were as follow:—

Ordinary.—Wednesday, £18 18s. 9d.; Thursday, £19; Monday, £19; Tuesday, £20; Wednesday, £19 18s. 9d.

Lead.—While a seasonal decline has been noted for this metal, the outlook is quite satisfactory, and an expansion in demand will not be long delayed. The statistical position of lead is sound. The situation on the Continent depends largely on the political trend. Industrial demand in the United States is heavy and is increasing.

Day-to-day quotations:—

Soft Foreign (Prompt).—Wednesday, £28 2s. 6d.; Thursday, £27 10s.; Monday, £28 3s. 9d.; Tuesday, £28 13s. 9d.; Wednesday, £27 18s. 9d.

Contracts Open

Chipping Norton, January 6.—16,200 yds. of 3-in. cast-iron water mains, for the Rural District Council. Mr. W. H. Bateman, consulting engineer, Batheaston, Bath. (Fee £2 2s., returnable.)

London (Tottenham), January 26.—Castings, for the Town Council. Mr. E. Townson, town clerk, Town Hall, Tottenham.

Morecambe, January 7.—170 yds. of 18-in. cast-iron pipe, for the Town Council. The Borough Surveyor, Town Hall. (Fee £2 2s., returnable.)

Saltash, January 7.—14 miles of 10-in., 9-in., 8-in. and 3-in. dia. spun-iron main and 1½ miles of 10-in., 9-in. and 8-in. dia. steel mains, for the South-East Cornwall Water Board. Lemon & Blizard, 24, Lockyer Street, Plymouth. (Fee £5 5s., returnable.)

Tunbridge Wells, January 18.—Cast-iron goods, for the Town Council. Mr. H. P. Bishop, borough surveyor, 1 and 2, Calverley Mount, Tunbridge Wells.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

John Peace & Sons, Limited, Algoma Works, Well Meadow Street, Sheffield.—Capital, £6,500. Steel and file manufacturers, etc. Directors: F. H. Peace, W. H. Peace, F. B. Peace, W. N. Peace, and O. S. Holmes.

Kay Metal Syndicate, Limited, Broadway House, 1a, Adelaide Road, London, N.W.3.—Capital, £13,000. Directors: M. A. Klauck and J. H. Jackson.

Steel Radiators, Limited, Beacon Works, Brentford.—Capital, £50,000. Directors: Capt. R. Von Heidenstam, A. T. Cooper, and W. J. Curtis.

George Rushworth & Son, Limited, Stanley Mills, Shaw Street, Colne.—Capital, £10,000. Engineers and steel merchants. Directors: G. C. Rushworth and J. Spencer.

For **"easy stripping"** use

YORKSHIRE SAND

Yorkshire Sand is of a synthetic nature, its production being under careful laboratory control. Perfect standardization is obtained with the various grades, suitable for light and the heaviest steel castings.

It is because of the refractoriness of the sand and of the toughness of the mould surface that castings made with Yorkshire Sand are distinguishable by their excellent finish.

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Read what an IMPORTANT STEELFOUNDER says :—

"During the 40 years I have been connected with Steel Foundry work, considerable changes have taken place. Away back, we had Steel Moulders' Composition, Old Crucible Pots, etc., and each works claimed to have its own 'secret' moulding composition. High Silica Sand has eliminated practically all these from many foundries and to-day we have your 'Yorkshire Sand' which acts almost like a chill, and leaves the skin of the casting blue-black and as clean as cast iron.

The hot steel lies quietly against the wall of sand, and often when the casting has been lifted out of the mould, the latter looks as if it could be used over again, just like a permanent mould."

RAW MATERIALS—PRICE LIST

(Wednesday, December 30, 1936)

COPPER

	£ s. d.
Standard cash	48 10 0
Three months	48 15 0
Electrolytic	53 0 0
Tough	52 10 0
Best selected	53 0 0
Sheets	81 0 0
India	62 5 0
Wire bars	54 5 0
Ingot bars	54 5 0
H.C. wire rods	57 15 0
Off. av. cash, Nov.	43 19 5 1/2
Do., 3 mths., Nov.	44 6 7 3/8
Do., Sttlmnt., Nov.	43 19 7 1/2
Do., Electro, Nov.	48 14 6 7/8
Do., B.S., Nov.	48 8 1 1/2
Do., wire bars, Nov.	48 19 9 1/2
Solid drawn tubes	12d.
Brazed tubes	12d.
Wire	7 1/4d.

BRASS

Solid drawn tubes	10 1/2d.
Brazed tubes	12 1/2d.
Rods, drawn	9 1/2d.
Rods, extd. or rlld.	5 1/2d.
Sheets to 10 w.g.	8 1/2d.
Wire	8 1/2d.
Rolled metal	8 1/2d.
Yellow metal rods	5 1/2d.

TIN

	£ s. d.
Standard cash	233 0 0
Three months	233 15 0
English	233 5 0
Bars	235 5 0
Straits	235 10 0
Australian	233 0 0
Eastern	232 0 0
Banca	235 0 0
Off. av. cash, Nov.	231 0 11 3/4
Do., 3 mths., Nov.	229 5 10
Do., Sttlmt., Nov.	231 0 11 3/4

SPELTER

	£ s. d.
Ordinary	19 18 9
Remelted	17 10 0
Hard	18 10 0
Electro 99.9	21 16 3
English	20 15 0
India	17 10 0
Zinc dust	22 15 0
Zinc ashes	5 7 6
Off. aver., Nov.	16 8 6 1/2
Aver. spot, Nov.	16 6 0 3/4

LEAD

	£ s. d.
Soft foreign ppt.	27 18 9
Empire	29 8 9
English	30 0 0
Off. aver., Nov.	21 14 2
Aver. spot, Nov.	21 14 5 1/2

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

	£ s. d. to £ s. d.
Zinc sheets, English	30 10 0 to 31 0 0
Do., V.M. ex-whse.	30 10 0 to 31 0 0
Rods	31 15 0

ANTIMONY

	£ s. d. to £ s. d.
English	72 0 0 to 73 0 0
Chinese, ex-whse.	58 0 0
Crude, c.i.f.	30 0 0

QUICKSILVER

	£ s. d.
Quicksilver	14 2 6

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	£8 17 6
45/50%	£11 0 0 to £12 5 0
75%	£16 2 6 to £17 7 6
Ferro-vanadium—	
35/50%	12/8 lb. Va
Ferro-molybdenum—	
70/75% carbon-free	4/6 lb. Mo.
Ferro-titanium—	
20/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£21 to £22
Ferro-tungsten—	
80/85%	3/1 1/2 lb.
Tungsten metal powder—	
98/99%	3/3 lb.
Ferro-chrome—	
2/4% car.	33 0 0
4/6% car.	21 10 0
6/8% car.	21 0 0
8/10% car.	21 0 0
Ferro-chrome—	
Max. 2% car.	33 10 0
Max. 1% car.	36 5 0
Max. 0.5% car.	37 5 0
70% carbon-free	9 1/2d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£184 0 0
Ferro-cobalt, 98/99%	7/3 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese—	
76/80% loose	£11 15 0 to 12 5 0
76/80% packed	£12 15 0 to 13 5 0
76/80% export	£10 15 0
Metallic manganese—	
94/96% carbon-free	1/3 lb.

Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under 1/2 in. to 1/4 in.	3d. lb.
Do., under 1/4 in. to 3/16 in.	1/- lb.
Flats, 1/2 in. × 1/4 in. to under 1 in. × 3/8 in.	3d. lb.
Do., under 1/2 in. × 1/4 in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

South Wales—	£ s. d.	£ s. d.
Heavy steel		3 4 0
Mixed iron and steel	3 0 0 to	3 2 0
Heavy cast iron	2 18 0 to	3 0 0
Good machinery	3 2 0 to	3 4 0
Cleveland—		
Heavy steel		3 2 6
Steel turnings		2 5 0
Heavy cast iron		3 10 0
Heavy machinery		3 12 6
Midlands—		
Light cast-iron scrap		2 15 0
Heavy wrought iron		3 7 6
Steel turnings		2 0 0
Scotland—		
Heavy steel		2 17 6
Ordinary cast iron	3 8 6 to	3 10 0
Engineers' turnings		2 2 6
Cast-iron borings		1 18 0
Wrot-iron piling	3 10 0 to	3 12 6
Heavy machinery	3 12 6 to	3 13 6

London—Merchants' buying prices, delivered yard.

	£ s. d.
Copper (clean)	41 0 0
Brass	24 0 0
Lead (less usual draft)	24 10 0
Tea lead	20 0 0
Zinc	11 0 0
New aluminium cuttings	74 0 0
Braziery copper	38 0 0
Gunmetal	37 0 0
Hollow pewter	170 0 0
Shaped black pewter	124 0 0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	83/6
,, No. 3	81/-
,, No. 4	80/-
Forge No. 4	80/-
Hematite No. 1	98/-*
Hematite M/Nos.	97/6*
N.W. Coast—	
Hem. M/Nos. d/d Glas.	98/-*
,, d/d Birm.	109/6*
Malleable iron d/d Birm.	—
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	83/-
,, No. 3 fdry.	86/-
Northants forge	80/6
,, fdry. No. 3	83/6
,, fdry. No. 1	86/6
Derbyshire forge	83/-
,, fdry. No. 3	86/-
,, fdry. No. 1	89/-
Scotland—	
Foundry, No. 1, f.o.t.	90/6
,, No. 3, f.o.t.	88/-
Cleveland No. 3, Glasgow	87/-
,, ,, Falkirk	84/-
Scottish hem. M/Nos. d/d	98/-*
Sheffield (d/d district)—	
Derby forge	80/6
,, fdry. No. 3	83/6
Lincs forge	80/6
,, fdry. No. 3	83/6
W.C. hematite	103/6*
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	89/-
Staffs fdry. No. 3	89/-
Northants fdry. No. 3	87/6
Cleveland fdry. No. 3	89/-
Glengarnock, No. 3	99/6
Clyde, No. 3	99/6
Monkland, No. 3	99/6
Summerlee, No. 3	99/6
Eglinton, No. 3	99/6
Gartsherrie, No. 3	99/6
Shotts, No. 3	99/6

* Subject to a rebate of 5s. per ton under certain conditions.

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.)		10 10 0
Nut and bolt iron	8 17 6 to	9 7 6
Hoops	11 7 6 and up.	
Marked bars (Staffs) f.o.t.		13 0 0
Gas strip	11 7 6 and up.	
Bolts and nuts, 1/2 in. × 4 in.		16 0 0 and up.
Steel—		
Plates, ship, etc.	9 10 6 to	9 13 0
Boiler plts.	10 0 6 to	10 3 0
Chequer plts.		11 3 0
Angles		9 3 0
Tees		10 3 0
Joists		9 3 0
Rounds and squares, 3 in. to 5 1/2 in.		10 3 0
Rounds under 3 in. to 1/4 in. (Untested)		9 10 0
Flats—8 in. wide and over		9 8 0
,, under 8 in. and over 5 in.		9 13 0
Rails, heavy	8 5 0 to	8 10 0
Fishplates		12 10 0
Hoops (Staffs)		10 5 0
Black sheets, 24g. (4-t. lots)		12 0 0
Galv. cor. shts. (,,)		14 0 0
Galv. flat shts. (,,)		14 10 0
Galv. fencing wire, 8g. plain		15 10 0
Billets, soft		6 5 0
Sheet bars	6 2 6 to	6 10 0
Tin bars	6 2 6 to	6 10 0

PHOSPHOR BRONZE

	Per lb. basis
Strip	11 1/2d.
Sheet to 10 w.g.	12 1/2d.
Wire	13 1/2d.
Rods	13d.
Tubes	15d.
Castings	13d.

Delivery 3cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1 1/2 to 1/7 1/2
To 15 in. wide	1/1 1/2 to 1/7 1/2
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2 1/2 to 1/8 1/2
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3 1/2
Ingots rolled to spoon size	10d. to 1/6 1/2
Wire round—	
to 10g.	1/4 1/2 to 1/11 1/2

with extras according to gauge.

Special 5ths quality turning rods in straight lengths, 1/3 1/2 upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	22.31
No. 2 foundry, Valley	20.50
No. 2 foundry, Birm.	16.88
Basic, Valley	20.00
Malleable, Valley	20.50
Grey forge, Valley	20.00
Ferro-mang. 80%, seaboard	80.00
O.-h. rails, h'y, at mill	36.37 1/2
Billets	32.00
Sheet bars	32.00
Wire rods	40.00
	Cents.
Iron bars, Chicago	1.80
Steel bars	2.05
Tank plates	1.90
Beams, etc.	1.90
Skelp, grooved steel	1.80
Steel hoops	1.95
Sheets, black, No. 24	2.60
Sheets, galv., No. 24	3.20
Wire nails	2.05
Plain wire	2.50
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	30/- to 32/6
,, furnace	24/6 to 25/-
Durham foundry	24/6
,, furnace	21/6
Scotland, foundry	27/-
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	19/9
,,	28×20 ,,	39 6
,,	20×10 ,,	28/-
,,	18 3/4×14 ,,	20/6
C.W.	20×14 ,,	16/- to 16/6
,,	28×20 ,,	34/6 to 35/-
,,	20×10 ,,	23/3 to 23/6
,,	18 3/4×14 ,,	16/6

SWEDISH CHARCOAL IRON & STEEL

	£ s. d. to £ s. d.
Pig-iron	£7 0 0 to £8 0 0
Bars-hammered, basis	£16 0 0 to £16 10 0
Bars and nail-rods, rolled, basis	£15 15 0 to £16 0 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£26 0 0 to £29 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, at'l	£11 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£ s. d.	
Dec.	23 ..	48 2 6	inc. 7/6
,,	24 ..	47 18 9	dec. 3/9
,,	28 ..	48 15 0	inc. 16/3
,,	29 ..	49 3 9	,, 8/9
,,	30 ..	48 10 0	dec. 13/9

Electrolytic Copper

		£ s. d.	
Dec.	23 ..	52 15 0	inc. 15/-
,,	24 ..	52 15 0	No change
,,	28 ..	53 0 0	inc. 5/-
,,	29 ..	53 15 0	,, 15/-
,,	30 ..	53 0 0	dec. 15/-

Standard Tin (cash)

		£ s. d.	
Dec.	23 ..	232 0 0	dec. 20/-
,,	24 ..	231 15 0	,, 5/-
,,	28 ..	233 10 0	inc. 35/-
,,	29 ..	235 10 0	,, 40/-
,,	30 ..	233 0 0	dec. 50/-

Tin (English ingots)

		£ s. d.	
Dec.	23 ..	232 5 0	dec. 20/-
,,	24 ..	231 15 0	,, 10/-
,,	28 ..	234 0 0	inc. 45/-
,,	29 ..	235 15 0	,, 35/-
,,	30 ..	233 5 0	dec. 50/-

Spelter (ordinary)

		£ s. d.	
Dec.	23 ..	18 18 9	No change
,,	24 ..	19 0 0	inc. 1/3
,,	28 ..	19 0 0	No change
,,	29 ..	20 0 0	inc. 20/-
,,	30 ..	19 18 9	dec. 1/3

Spelter (Electro, 99.9 per cent.)

		£ s. d.	
Dec.	23 ..	20 16 3	dec. 1/3
,,	24 ..	20 17 6	inc. 1/3
,,	28 ..	20 17 6	No change
,,	29 ..	21 17 6	inc. 20/-
,,	30 ..	21 16 3	dec. 1/3

Lead (soft foreign, prompt)

		£ s. d.	
Dec.	23 ..	28 2 6	inc. 20/-
,,	24 ..	27 10 0	dec. 12/6
,,	28 ..	28 3 9	inc. 13/9
,,	29 ..	28 13 9	,, 10/-
,,	30 ..	27 18 9	dec. 15/-

Lead (English)

		£ s. d.	
Dec.	23 ..	30 0 0	inc. 15/-
,,	24 ..	29 10 0	dec. 10/-
,,	28 ..	30 0 0	inc. 10/-
,,	29 ..	30 10 0	,, 10/-
,,	30 ..	30 0 0	dec. 10/-

AVERAGE MONTHLY PRICES OF FURNACE COKE D/D MIDDLESBROUGH

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1904	0 13 9	0 13 9	0 13 3	0 14 3	0 14 6	0 14 3	0 14 3	0 14 3	0 14 3	0 14 0	0 14 0	0 14 6	0 14 1½
1905	0 14 9	0 15 3	0 15 3	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 9	0 17 0	0 15 5½
1906	0 17 6	0 17 6	0 17 0	0 17 0	0 17 0	0 16 6	0 17 0	0 17 0	0 18 3	0 18 6	0 19 0	1 0 0	0 17 8½
1907	1 4 6	1 5 0	1 5 0	1 0 6	1 2 0	1 1 0	1 1 0	1 1 0	1 2 0	1 1 6	1 0 0	0 17 0	1 1 8½
1908	0 16 0	0 16 0	0 15 6	0 16 0	0 16 3	0 16 0	0 15 6	0 15 6	0 15 6	0 15 6	0 16 0	0 15 9	0 15 9½
1909	0 16 0	0 15 3	0 15 0	0 14 9	0 15 6	0 15 9	0 15 6	0 15 6	0 16 6	0 17 0	0 17 6	0 17 9	0 15 11½
1910	0 18 4½	0 18 6½	0 18 0	0 18 0	0 17 10½	0 17 0	0 16 1½	0 15 9½	0 15 11	0 16 0	0 15 9½	0 15 8	0 16 11
1911	0 16 0	0 15 10½	0 15 6	0 15 3	0 14 9	0 14 6	0 14 6	0 14 6	0 14 6	0 14 11½	0 15 0½	0 16 3½	0 15 1½
1912	0 17 3	0 17 3	0 18 6	0 18 10	0 19 0	0 19 4½	0 19 10½	1 0 9½	1 2 9	1 4 1½	1 5 8½	1 6 6	1 1 0
1913	1 5 9	1 4 11	1 5 0	1 5 0	1 4 9½	1 0 4½	0 19 5½	0 18 2	0 18 0	0 18 2½	0 18 6	0 18 6	1 1 4½
1914	0 18 2	0 17 1	0 17 0	0 17 0	0 17 4	0 17 6	0 17 6	0 18 5	0 18 4	0 17 9	0 17 6	0 18 5	0 17 8
1915	0 17 10½	0 17 9	1 0 4½	1 7 7½	1 9 4½	1 10 7½	1 9 7	1 7 3	1 5 4	1 4 9	1 9 6	1 13 0	1 6 1
1916	1 10 9	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6½
1917	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 14 3	1 15 6	1 11 2½
1918	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6
1919	1 15 6	1 15 6	1 15 6	1 15 6	2 1 6	2 1 6	2 3 9	2 10 6	2 10 6	2 10 6	2 10 6	2 10 6	2 3 5
1920	2 12 3	2 14 0	2 19 0	2 19 0	3 3 8	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 2 6
1921	3 1 0½	2 19 0	2 16 0	2 7 0	2 6 6	2 6 6	2 0 6	2 0 0	1 13 11	1 12 9	1 10 4½	,, ,,	2 3 6½
1922	1 7 0½	1 8 1½	1 9 7½	1 8 4½	1 7 11½	1 7 3	1 6 9½	1 6 10½	1 7 0½	1 10 2½	1 10 0	1 9 11½	1 8 3½
1923	1 11 3	1 14 6	2 0 1½	2 2 8½	2 4 4½	2 2 10½	2 1 0½	2 1 6	2 0 9½	1 18 9	1 18 8½	1 18 3	1 19 7½
1924	1 16 6½	1 14 9	1 11 11½	1 10 0½	1 8 1½	1 7 8½	1 7 3	1 6 3	1 6 0	1 5 0	1 5 0	1 5 0	1 9 5½
1925	1 4 10½	1 4 1½	1 13 3	1 2 4½	1 2 2½	1 1 5½	1 1 3½	1 4 9	0 18 10½	0 18 4½	0 19 6½	1 1 4½	1 2 8½
1926	1 2 1½	1 0 9	0 19 2½	0 18 6½	*	*	*	*	*	*	*	1 5 0	1 1 1½‖
1927	1 5 6	1 4 9½	1 6 1½	1 3 9	1 2 6	1 0 8½	0 19 4½	0 19 0	0 18 7½	0 18 0	0 17 10½	0 17 6	1 1 1½
1928	0 17 6	0 17 10½	0 18 0½	0 17 11½	0 17 8½	0 17 6½	0 17 7½	0 17 6½	0 17 6	0 17 7½	0 17 7½	0 17 6	0 17 8
1929	0 17 7½	0 18 0	0 19 0	0 19 6½	0 18 10½	0 19 10½	1 1 3½	1 1 8½	1 3 0	1 3 6	1 3 8	1 3 1½	1 0 9½
1930	1 2 6½	1 1 3	1 0 3	0 19 1½	0 17 7	0 16 10½	0 16 6	0 16 6	0 16 9	0 17 0	0 17 0	0 17 0	0 18 2½
1931	0 17 0	0 16 7½	0 16 0	0 16 0	0 15 11	0 15 5	0 15 1	0 15 0	0 15 0	0 16 9	0 17 0	0 16 6	0 16 0½
1932	0 17 0	0 16 11½	0 16 5½	0 15 9	0 15 7½	0 15 6	0 15 6	0 14 9½	0 14 6½	0 14 6	0 15 4	0 15 6½	
1933	0 16 0½	0 15 11½	0 15 6½	0 15 6	0 15 6	0 15 6	0 15 6	0 15 8½	0 16 1½	0 17 0	0 17 6	0 18 0	0 16 1½
1934	0 19 1½	1 0 6	1 0 2	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	0 19 11½
1935	1 0 0	0 19 6½	0 19 0½	0 19 0	0 19 0	0 19 0	0 19 0	0 19 0	0 18 9½	0 18 9½	0 19 3½	1 1 2½	0 19 2½
1936	1 2 0	1 2 11½	1 3 2½	1 4 0	1 4 11½	1 4 3½	1 5 1	1 4 7½	1 4 6	1 4 6	1 4 6	1 4 6	1 4 1

* Strike period. ‖ Five months.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

NON-FERROUS Foundry Foreman, 14 years' experience in Admiralty contracts. Good references.—Box 156, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ESTIMATOR wanted. Used to foundry work, light engineering trade, both ferrous and non-ferrous. Apply stating age, experience in chronological order, and salary required, to AERO ENGINES, LIMITED, Kingswood, Bristol.

ASSISTANT Works Manager required for important engineering works with large non-ferrous foundry. Only first-class men need apply, stating age, experience, and salary required.—Box 148, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED. — First-class Loam Moulder. Full details, wage and experience to Box 154, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED for Leicestershire, a young Foundry Clerk to act as Assistant to Costs Clerk. Apply giving age, experience, references, and salary required.—Box 158, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED.—Reliable and capable Foreman for small non-ferrous ingot manufacturers, Birmingham district. Applications treated in strict confidence. Write stating experience, wages, etc.—Box 152, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRYMAN with 20 years' experience as foundry manager and foreman, desires similar position. Vast experience in iron, brass, steel and aluminium castings for marine and locomotive engineering. Good estimator, plate machine, metal mixer, green, dry and chill mould casting. (292)

ASSISTANT Foundry Manager desires re-engagement. Experience includes in charge of highly mechanised plant, also general engineering jobbing experience. Fully competent to control metal mixtures, cupola management. Has had some laboratory experience, sound technical training. (293)

AGENCY

ESTABLISHED Irish Free State Foundry desires to communicate with English or Scottish foundry with view to expanding and developing manufacture of cast iron goods, enamelling and galvanising processes, etc. Replies in strict confidence.—Box 150, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

AUCTION SALE

THE FOUNDRY, LONG MELFORD, SUFFOLK.

IMPORTANT TWO DAYS' SALE OF EXTENSIVE STOCK IN TRADE OF AN AGRICULTURAL IMPLEMENT MAKER AND IRONMONGER,

including :

New Implements, Agricultural Machine and Implement Parts, Complete Equipment of Carpenters', Fitters', Smiths' and Painters' Shops; Valuable Trade Patterns, Extensive Ironmongery Stock, Office Furniture.

For Sale by Auction by
MESSRS. BOARDMAN & OLIVER,
on
MONDAY AND TUESDAY, JANUARY 11 AND 12, at 10 a.m. prompt each day.

For David Ward, Esq., who has sold the Property.

Catalogues from the Auctioneers, Sudbury, Suffolk.

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1936 edition. Price 42s. cloth bound, 52s. Morocco. Order your copy now.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & Co., LTD., Station Works, Ecclesfield, Sheffield.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

Tilghman Sandblast Barrel Plants; barrel sizes—60 in. x 40 in.; 36 in. x 20 in.; 20 in. x 30 in.

Tilghman Sandblast Cabinet Plants; 4 ft. 6 in. and 3 ft. 6 in. square (one for high pressure 70 lbs. per sq. in.); also small Cabinet 30 in. dia.

All complete with Air Compressors, etc.

Gas and Air Mixer by Sharpe & Preston, 2-in. outlet.

Six Osborne Pneumatic Jolt Press Moulding Machines, size 75J.

Three Mumford Yoke Headpress Pneumatic Moulding Machines.

Two Herbert Whizzer Sand Disintegrators.

Two Brealey Type ditto.

Heavy Double-ended Grinding Machines by Rowlands, Luke & Spencer, etc.

Hand Moulding Machines by Adaptable Darling & Sellars, Pridmore, Samuelson, etc.

500 Electric Motors, Dynamos, Rotary Converters, etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

THOS. W. WARD LTD.

Several HYDRAULIC MOULDING PRESSES; 10" ram; 2,240 lbs. per sq. in. press.

50-ton HYDRAULIC MOULDING PRESSES; 8" ram; 2,240 lbs. per sq. in. press.

Three LANCS. BOILERS; 30' x 8'; 150 lbs. w.p.

Number of SAFES, all sizes.

Write for "Albion" Catalogue.

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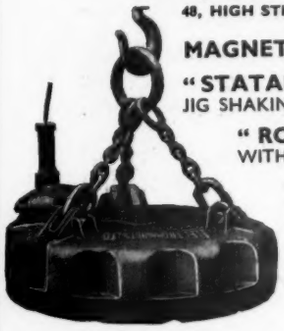

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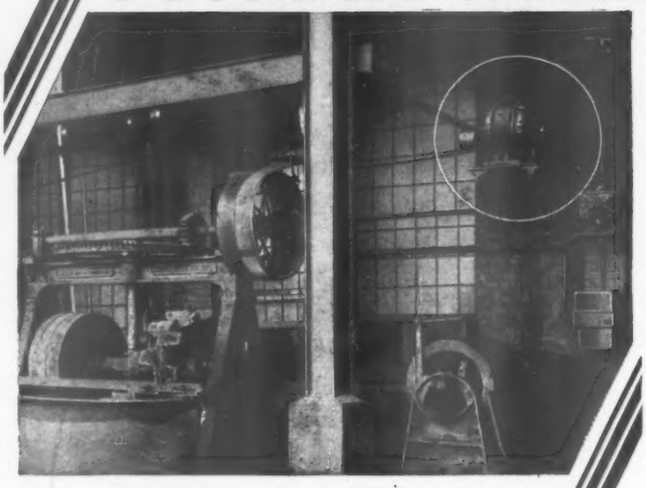

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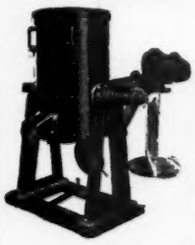

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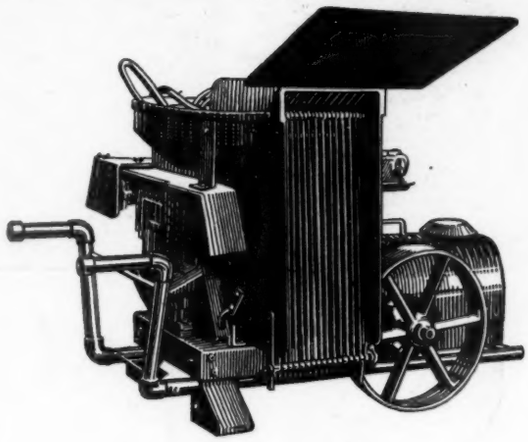

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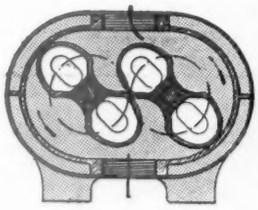

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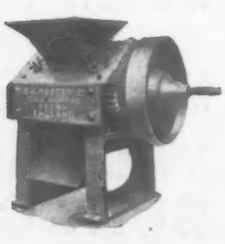

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